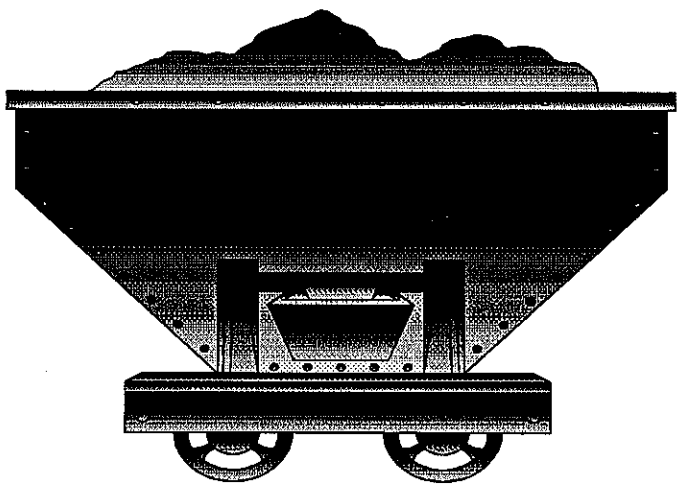
CUSTOM COALS INTERNATIONAL

INFORMATION PACKET



Custom Coals International

Post Office Box 23575
Pittsburgh, Pennsylvania 15222
Tel: (412) 393-6534
Fax: (412) 393-6157

Enclosed are background materials concerning Custom Coals International - a joint venture of Genesis Research and Duquesne Light. The packet includes technical information about our Carefree™ and Self-Scrubbing™ coal technologies, press clippings and a description of our test program.

We at Custom Coals are very excited about the compliance strategies created by our products. While we recognize compliance coal is not the right answer in every situation, we believe we can demonstrate how a Custom Coals product can provide you with a competitive edge. In any time of change, such as that caused by the Clean Air Act amendments, risks and opportunities abound. Those who establish a competitive edge through their compliance strategies will distinguish themselves as well-managed, forward-looking companies.

Let us show you how Custom Coals' technology can help you turn adversity into opportunity.

Sincerely,

Robin L. Godfrey

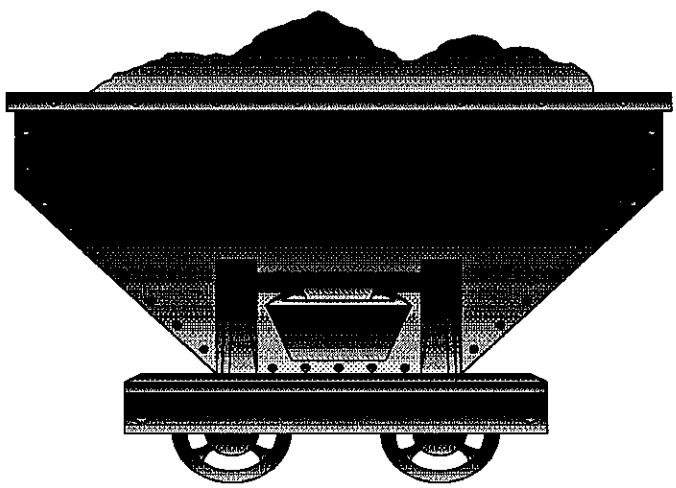
Robin L. Godfrey
Executive Vice President

RLG/mb

Enclosures

A Joint Venture of
Duquesne Light Company
and Genesis Research
Corporation

TECHNICAL INFORMATION



MIDDLINGS GRINDING AND NOVEL FINE-COAL CLEANING PRODUCES FEEDSTOCK FOR SELF-SCRUBBING COAL

to be presented at the

EIGHTH ANNUAL INTERNATIONAL
PITTSBURGH COAL CONFERENCE

October 14 - 18, 1991

by

James Kelly Kindig, Ph.D.

INTRODUCTION

The sulfur content of most coals east of the Mississippi River is too high to meet the emission limitation which will be imposed in the year 2000 (1.2 pounds of sulfur dioxide per million Btu). The compliance strategies favored by most utilities for meeting these limitations, therefore, are switching to low sulfur coal or scrubbing the combustion gases. Both have serious drawbacks.

Switching puts local miners out of work by importing low sulfur coal. Powder River Basin coal if burned in boilers designed for bituminous coals results in a loss of generating capacity. Switching generally disregards the economy in a utility's service territory.

Scrubbing requires a major capital expenditure by the utility. This expenditure buys a scrubber which increases operating complexity and costs and carries its own environmental issue, scrubber sludge.

Through new technologies, two compliance-coal products can be produced by Custom Coals International from most of the non-compliance coals east of the Mississippi River. They are termed Carefree™ and Self-Scrubbing™ Coal.

- *Carefree Coal is produced solely through the aggressive removal of ash and pyritic sulfur from non-compliance bituminous coal feedstocks.* Carefree Coal is composed of coarse coal, fine coal and ultra-fine coal[1]. Some of the ultra-fines may be agglomerated.

- *Self-Scrubbing Coal is comprised of aggressively beneficiated coal and a patented mixture of sorbent and promoter.* It is comprised of coarse coal, fine coal and agglomerates. The additives are agglomerated with the ultra-fine clean coal for convenience in handling.

  For Self-Scrubbing Coal, the reduction of sulfur to compliance levels occurs in two stages. Pyrite, an iron-sulfur compound, is first removed by aggressive coal beneficiation. Sulfur dioxide, generated in the boiler from the coal's organic sulfur and residual pyritic sulfur, is then captured by the additives.

---

[1] Coarse coal, plus 1/2 mm (0.500 mm); fine coal, 1/2 mm by 150 mesh (0.500- by 0.106 mm); and ultra-fine coal, 150 mesh by 15 microns (0.106- by 0.015 mm).

Carefree and Self-Scrubbing Coals satisfy the newly imposed sulfur dioxide limitations. They are derived from local coals and, therefore, are compatible with the boiler; they are priced competitively with compliance coals imported into the local region; and no capital investment is required by the utility.

The net effect of CCI's technologies is that they revalue most non-compliance reserves to compliance reserves. The major steps in effecting that transformation are given below.

LIBERATION, THE FIRST REQUIREMENT

Raw coal may be viewed as a physical mixture of four types of particles. Three of these are liberated, meaning that they are comprised of more-or-less pure components. They are organic material ("pure" coal), specific gravity slightly less than 1.30; rock, specific gravity averaging about 2.80; and pyrite, specific gravity 5.00.

The fourth type of particle is locked, meaning that it consists of two or three of the pure components bound together. This locking of organic material with rock and pyrite gives rise to the spectrum of specific gravities characteristic of raw coal. For most raw coals, material which floats at 1.30 is "pure" coal; material which sinks at 2.00 is a combination of rock and pyrite; and material which sinks at 1.30 and floats at 2.00 is comprised of locked particles also called middlings. The amount of middlings in Eastern coals is substantial and varies considerably; fifty percent might be typical.

In conventional coal cleaning, these locked particles must report either to the clean coal or refuse. Both of these are undesirable. If locked particles report to the clean coal, unwanted sulfur and ash are carried into the product; if they report to refuse, valuable coal is lost.

The extent to which the rock and pyrite liberate from the coal matrix upon crushing and grinding is a major factor determining the ease, and therefore cost, of producing a compliance coal. Crushing and grinding to minus 1/2 mm to achieve liberation of pyrite (sulfur) from the coal is not generally practiced by the U.S. coal industry.

Locked particles can be freed by comminution. There must be available, however, an efficient method for separating the resulting fine raw coal into a clean coal product essentially free of pyrite and refuse.

THE CAREFREE FINE COAL CLEANING PROCESS, THE SECOND REQUIREMENT

The widespread use of conventional dense media cycloning attests to its superior performance and versatility in beneficiating intermediate and small-size raw coal. Cleaning raw coal finer than 1/2 mm in conventional dense media cyclones, however, gives poor results. Efficiency drops off sharply, and the separation gravity rises dramatically as particle size decreases. Both are undesirable. Both are also consequences of two theoretical limitations of commercial dense media cyclones for properly sorting fine particles.

These limitations are:

1. *The medium is not homogeneous with respect to the fine size of the raw coal.* Stated another way, the particle size of the commercial magnetite comprising the media is too large.

   To illustrate, as the size of a particle of coal approaches the size of the magnetite comprising the media, the coal particle ceases to be submerged in media, which would buoy it up into the clean coal product. Rather, the coal particle is increasingly immersed in water in which it sinks, thereby becoming coal which is misplaced to refuse.

2. *The forces operating on fine particles inside a conventionally designed and operated cyclones are too weak with respect to the fluid resistance to impart the velocity required for separation.*

To obviate these two theoretical limitations the following steps were taken.

1. A new extraordinarily-fine magnetite was developed which is minus 5 microns (0.005 mm). This extraordinarily-fine magnetite eliminates the problem of conventional magnetite which is too coarse to be effective in cleaning fine and ultra-fine coal.

2. Both the design and operating conditions of the cyclone were altered to overcome the problem of forces being too weak to effectively clean fine coal without, at the same time, overloading the cyclone.

The minus 5-micron magnetite and cyclone modifications constitute the heart of the Carefree Fine Coal Cleaning Process. All aspects of this novel dense media cleaning system including minus 5-micron magnetite recovery were demonstrated on a small but commercial scale at CQ Inc.

in Homer City, Pennsylvania. CQ Inc. is a wholly-owned subsidiary of EPRI.

Excellent, and essentially identical, separation efficiencies were obtained in both 2-inch and 10-inch diameter cyclones. For example, the probable error for the 10-inch diameter cyclone cleaning 1/2 mm by 150 mesh raw coal is 0.03, and, for cleaning 150 mesh by 15 micron raw coal is 0.07. Actual unadjusted partition curves are given in Figures 1 and 2.

AN INTEGRATED FLOWSHEET, THE THIRD REQUIREMENT

An integrated flowsheet was designed to convert non-compliance coals into compliance coals. It first removes whatever liberated clean coal and refuse are present in the coarse raw coal, then comminutes the resulting coarse middlings. This method of minimizing the quantity of material requiring comminution and therefore advancing to the fine circuits is termed the "basic cleaning unit." It is shown in Figure 3, and described below:

1. *Size the feed coal with screens (or classifying cyclones) and process the oversize as described below.*

2. *Separate the feed coal, by dense media cleaning, at an unusually low specific gravity, for example 1.30.* This recovers an exceptionally clean coal.

3. *Separate the remaining material from Step 2 above, also by dense media cleaning, at an unusually high specific gravity, for example 2.00.* This (a) rejects a high-ash refuse barren of coal, and (b) produces a middling fraction for further treatment.

4. *Comminute the middlings to achieve additional liberation of pyrite and other ash-forming minerals from the organic material.*

5. *Size the comminuted middlings with the devices mentioned in Step 1.* The comminuted material reports to the undersize, along with fines in the raw coal, thus advancing to the next basic cleaning unit where newly liberated coal and refuse are removed.

6. *Repeat the above five steps until sufficient liberation is reached to achieve target sulfur reductions, at which point only a two-product separation is required.*

DISTRIBUTION CURVE: TEN-INCH DIAMETER CAREFREE DENSE MEDIUM CYCLONE
Feed Size: 28- by 150 Mesh

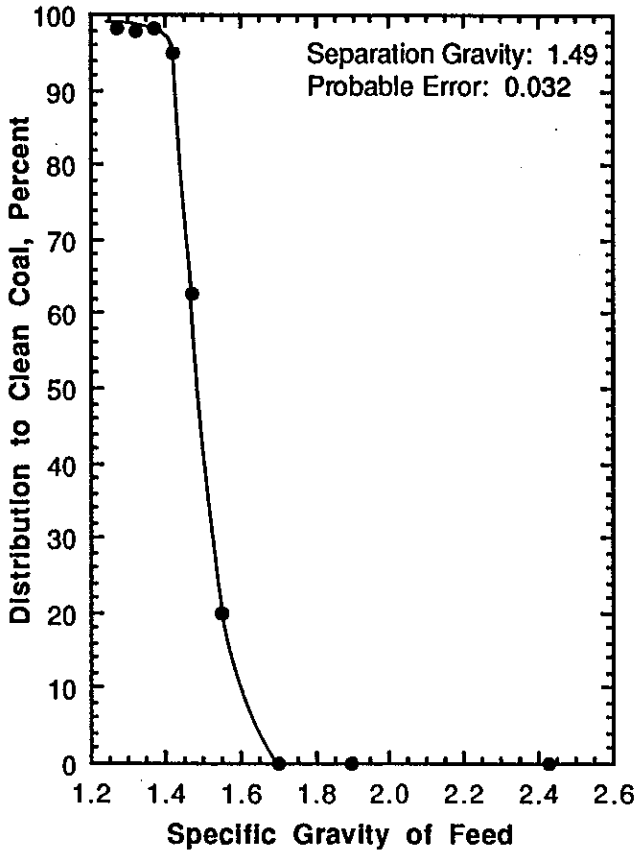


Figure 1

DISTRIBUTION CURVE: TEN-INCH DIAMETER CAREFREE DENSE MEDIUM CYCLONE
Feed Size: 150 Mesh by 15 Microns

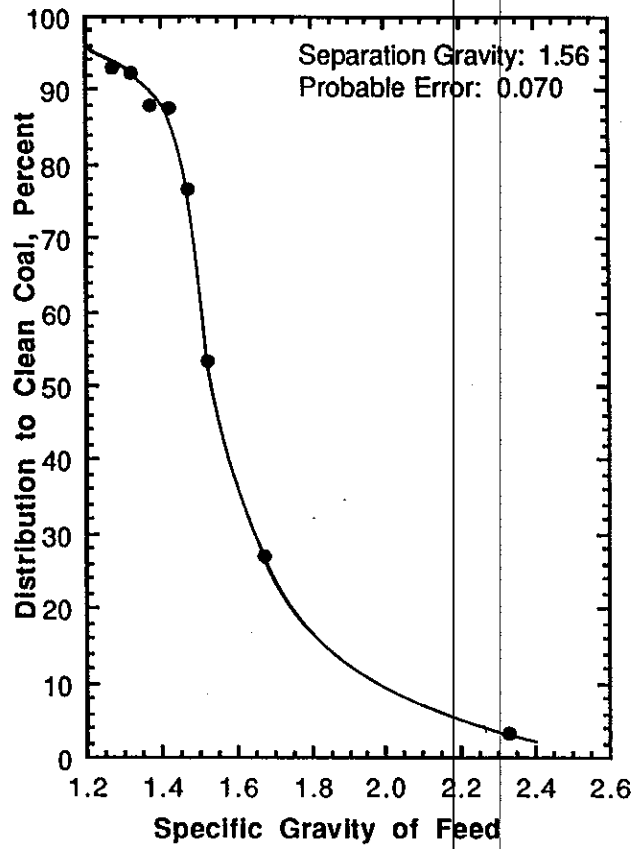
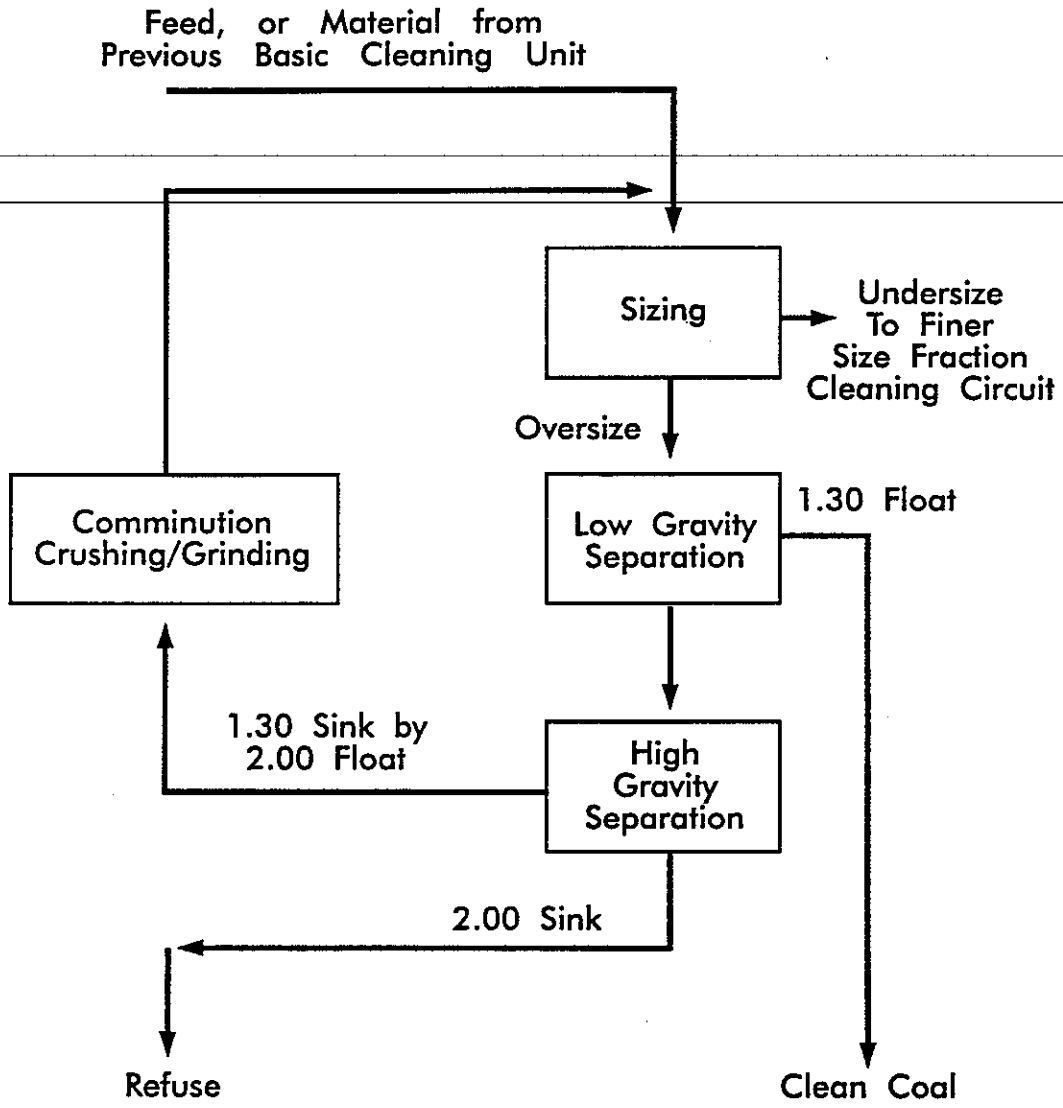


Figure 2



For Each Size Fraction Separate and Remove Liberated Clean Coal and Refuse. Comminute (Crush or Grind) Middlings, Locked Material.

Figure 3. BASIC CLEANING UNIT

CLEANING THE MINUS 1/2 MM RAW COAL FINES

In a middlings-grinding flowsheet, one-half of the total raw coal may be cleaned at minus 1/2 mm. This is three to four times as much as for conventional coal cleaning. An unusually efficient fine coal cleaning technology, therefore, is imperative.

The Carefree Fine Coal Cleaning Process for beneficiating minus 1/2 mm raw coal is described below.

- *Size the coal at 150 mesh (0.106 mm).* A two-stage Krebs[2] VariSieve™ (modified rapped sieve bend) is used to make this separation.

- *Disengage the minus 15 micron (0.015 mm) clay slimes from the minus 150 mesh raw coal.* This is achieved through a countercurrent classifying cyclone circuit. Specially designed and operated 10-inch diameter (Carefree) classifying cyclones are used to make the 15-micron cut.

- *Beneficiate two size fractions in dense media cyclones. The two size fractions are: raw coal fines, previously sized at 1/2 mm by 150 mesh (0.500- by 0.106 mm), and the raw coal ultra-fines, previously sized at 150 mesh by 15 microns (0.106- by 0.015 mm).* This beneficiation occurs in specially designed and operated (Carefree) dense media cyclones. The media is comprised of extraordinarily fine magnetite (minus 5-microns). The two size fractions are cleaned separately to maximize cleaning efficiency and facilitate recovery of the minus 5-micron magnetite.

- *Recover the minus 5-micron magnetite from the 1/2 mm by 150 mesh fines by employing the drain-and-rinse concept common in conventional dense media circuits.* VariSieves are used for both the drain and rinse screens.

  Minus 5-micron magnetite is removed from the clean coal (or refuse) as it flows across two rinse VariSieves in series. Rinsing is performed by countercurrent flow of the wash water. Additional magnetite and moisture are removed on a final vibrating dewatering screen.

- *Separate and recover the minus 5-micron magnetite from the 150 mesh by 15 micron ultra-fines through a series of wet drum magnetic separators arranged in a rougher-cleaner-scavenger configuration.*

---

[2] Krebs Engineers, Menlo Park, California.

The rougher is a standard triple-drum separator with barium ferrite elements, relatively weak magnets. The rougher concentrate is re-cleaned in the cleaner separator, also a standard wet-drum separator with barium ferrite magnets. The scavenger, which reprocesses non-magnetics from both rougher and cleaner, is a wet drum separator containing both barium ferrite and the much stronger rare earth magnets.

- *Dewater the 1/2 mm by 150 mesh clean coal in a standard fine coal centrifuge.*

- *Dewater the 150 mesh by 15 micron clean coal in a high-"G" centrifuge or vacuum filter.* The prior removal of minus 15 micron clay slimes aids in attaining lower moisture values.

- *Agglomerate the 150 mesh by 15 micron ultra-fines.*

  In some instances where the total clean coal product is in compliance (Carefree Coal), agglomeration of the ultra-fines may not be necessary, just as ultra-fines are not agglomerated from coal preparation plants today. If the total clean coal product is not in compliance, however, the Self-Scrubbing additives for all the coal are mixed with the ultra-fines prior to agglomeration.

  The three elements of the agglomeration system are the binder, the mixer and the compaction device.

  The binder for the agglomeration process, developed in Britain, is a two-component binder. The two liquids are mixed, sprayed onto the ultra-fine coal and the mixture blended. This initiates a mild exothermic reaction which begins to "set" or bind the coal particles together without the use of heat. The blended ultra-fine coal and binder are then either briquetted or passed through a pellet press. The briquets or extrudates (pellets) harden immediately due to the binder thereby forming waterproof agglomerates.

CONCLUSIONS

Most Eastern coals can be brought into long-term compliance either through (1) an aggressive physical coal cleaning process which produces Carefree Coal, or (2) a combination of aggressive cleaning plus additives which are agglomerated with the coal ultra-fines to produce Self-Scrubbing Coal. The coal cleaning process:

- Recovers an exceptionally clean coarse coal, rejects an exceptionally high-ash coarse refuse and produces middlings,

- Crushes or grinds the middlings to liberate pyrite, "pure" coal and rock for subsequent processing,
- Sizes the raw coal fines at 1/2 mm and 150 mesh (0.106 mm),
- Removes the minus 15-micron (0.015 mm) clay slimes from the raw coal by a new classification method,
- Efficiently cleans the raw coal fines (1/2 mm by 150 mesh) and ultra-fines (150 mesh by 15 microns) by a novel dense media process,
- Recovers the minus 5-micron magnetite for re-use, and
- Agglomerates the additional ultra-fines produced by the aggressive beneficiation.

DEMONSTRATED COAL RESERVES EAST OF THE MISSISSIPPI WHICH CAN BE CONVERTED INTO COMPLIANCE COAL BY CUSTOM COALS INTERNATIONAL

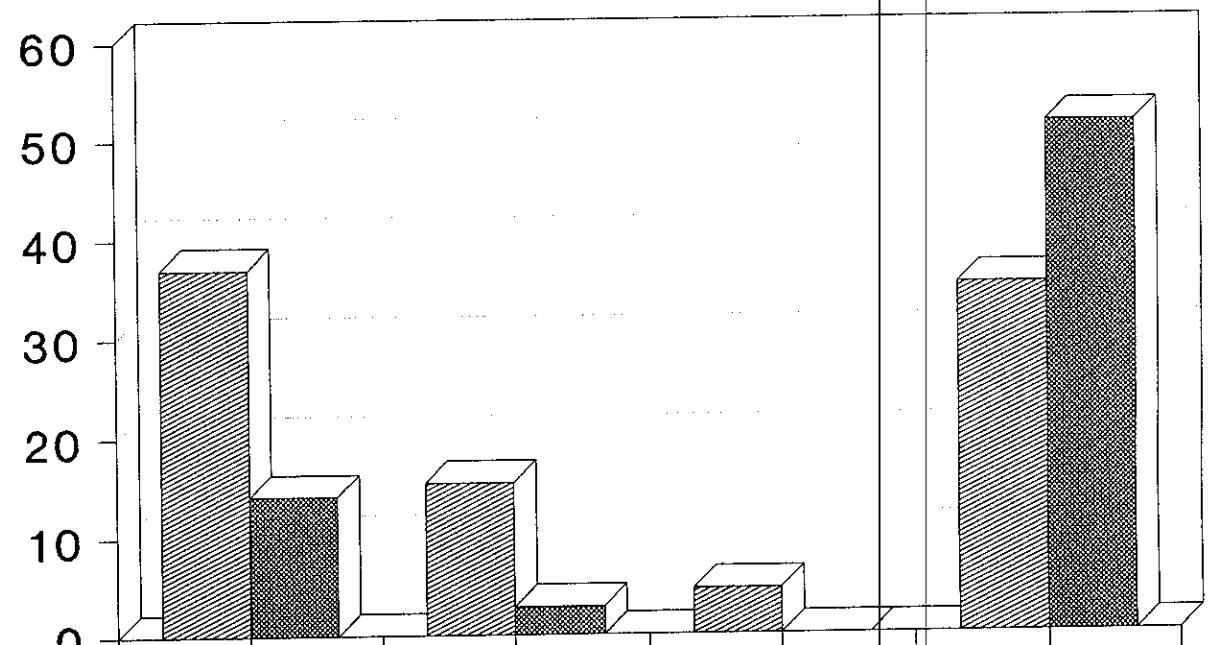
MILLIONS OF 1987 SHORT TONS

STATE	CAREFREE COAL	SELF-SCRUBBING COAL
MARYLAND	721	663
OHIO	8,104	8,981
PENNSYLVANIA	19,076	1,783
WEST VIRGINIA	9,048	2,677
Northern Appalachia Total	36,949	14,104
KENTUCKY	5,130	189
TENNESSEE	348	0
VIRGINIA	915	0
WEST VIRGINIA	9,048	2,677
Central Appalachia Total	15,442	2,866
ALABAMA	4,245	0
TENNESSEE	348	0
Southern Appalachia Total	4,594	0
ILLINOIS	24,346	38,005
INDIANA	4,738	3,396
KENTUCKY	6,158	10,133
Illinois Basin Total	35,241	51,534
GRAND TOTAL	92,226	68,504

Reserve Information Source:
U.S. DOE/EEI, "Estimation of U.S Coal Reserves by Coal Type"

DEMONSTRATED COAL RESERVES EAST OF THE MISSISSIPPI WHICH CAN BE CONVERTED INTO COMPLIANCE COAL BY CUSTOM COALS INTERNATIONAL

Figures in billions of 1987 short tons.



	NORTHERN APPALACHIA	CENTRAL APPALACHIA	SOUTHERN APPALACHIA	ILLINOIS BASIN
CAREFREE COAL	37	15	5	35
SELF-SCRUBBING COAL	14	3	0	52

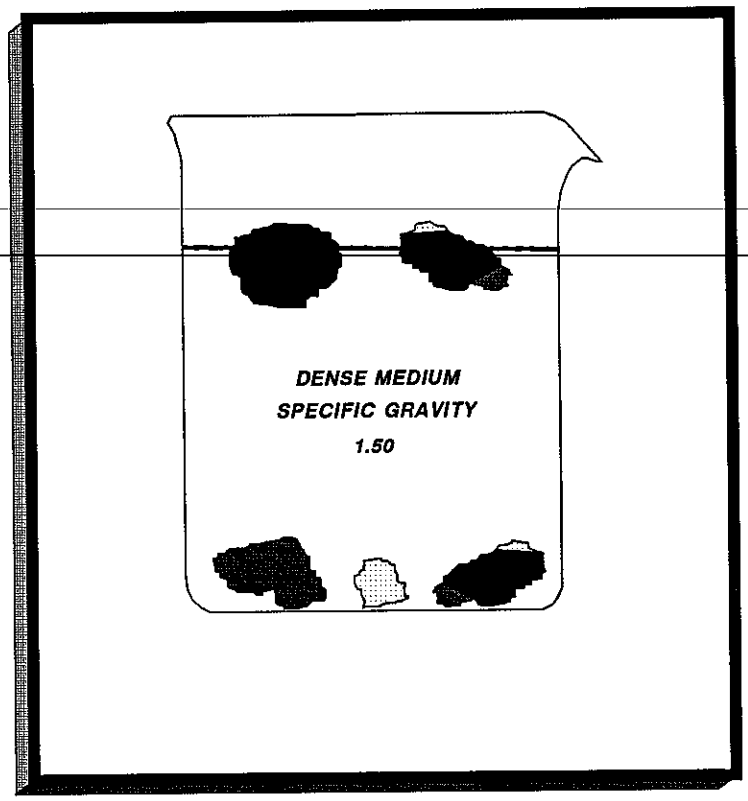
Reserve Information Source:

U.S. DOE/EIA, Estimation of U.S. Coal Reserves by Coal Type

Types of Particles in Run-of-Mine (ROM) Coal

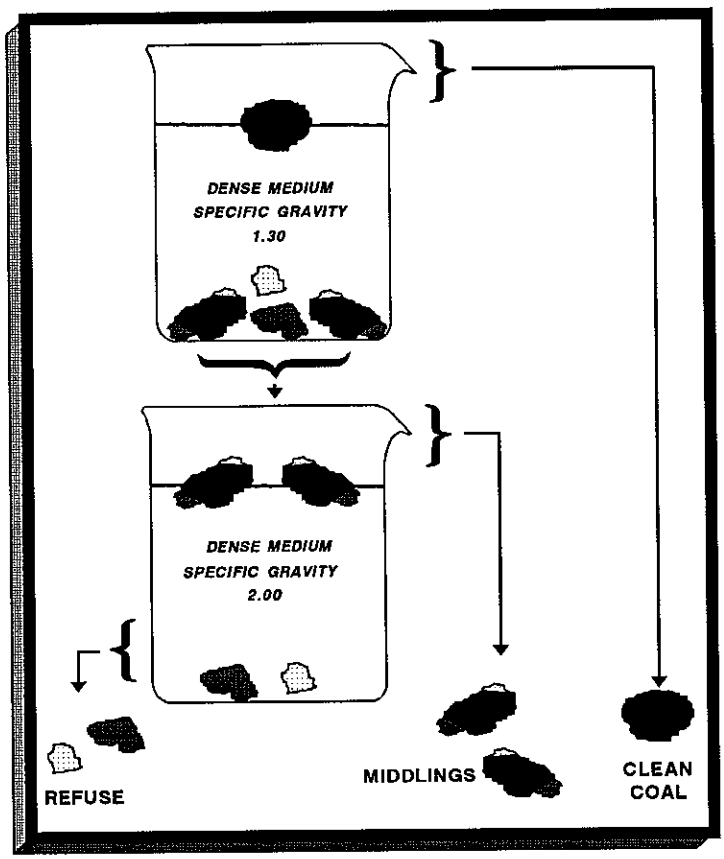
SYMBOL	MATERIAL	SPECIFIC GRAVITY	PARTICLE TYPE
	COAL	1.30	FREE
	REFUSE	2.60	FREE
	PYRITE	5.00	FREE
	MIDDLING	1.55	LOCKED
	MIDDLING	1.45	LOCKED

Separation of ROM Coal Particles by Conventional Dense Medium Process

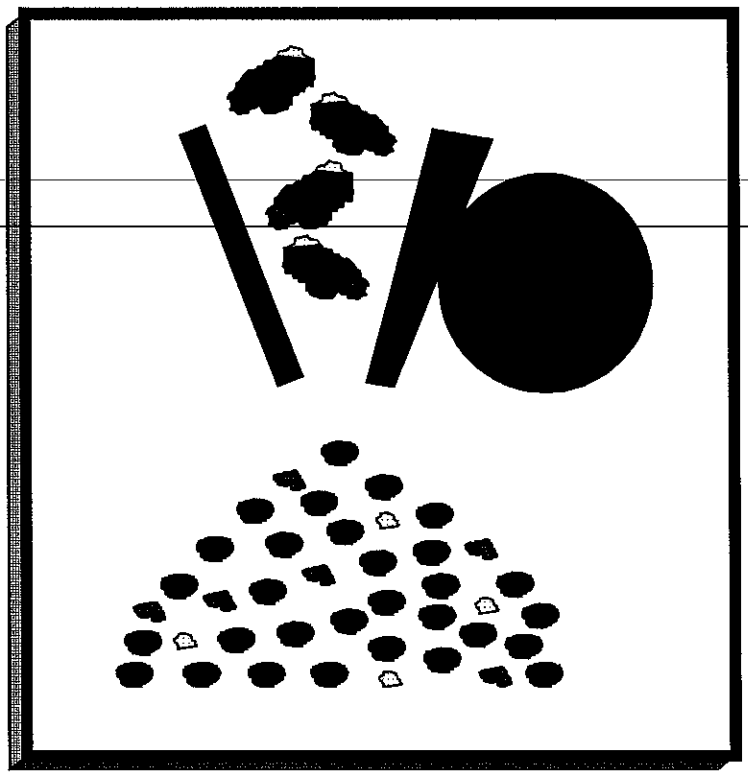


Three Product Separation

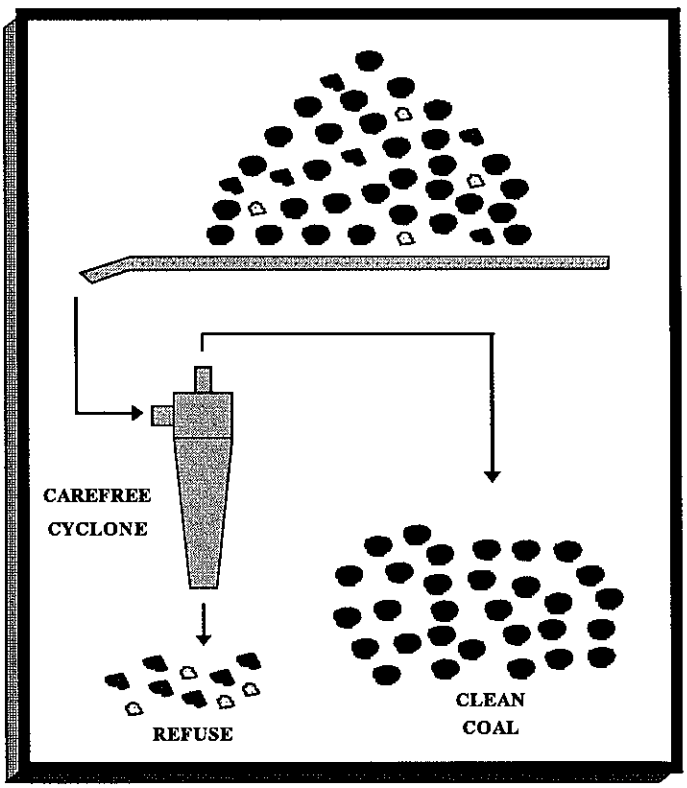
Initial Step in Producing Carefree™ & Self-Scrubbing™ Coal



Liberating Pyrite and Coal by Crushing and Grinding the Middlings



Beneficiating Crushed Middlings to Reject Pyrite and Recover Additional Clean Coal



Controlling the Cost of Clean Air — A New Clean Coal Technology

By James Kelly Kindig and Robin L. Godfrey

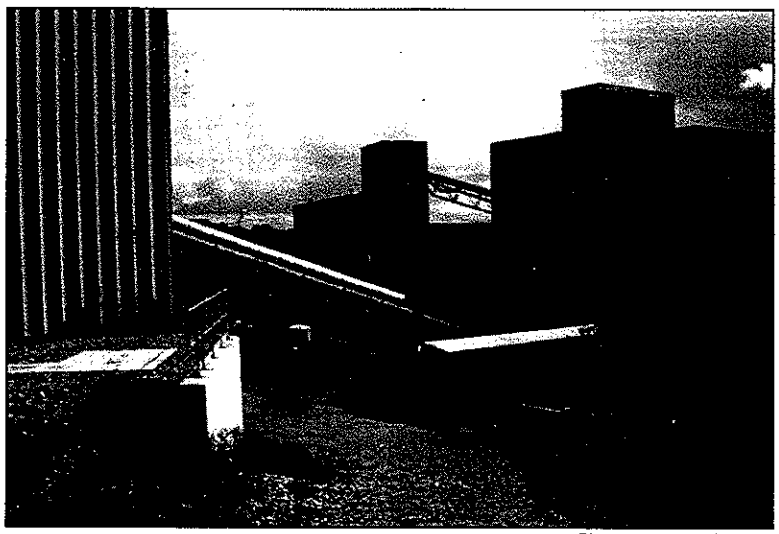


Photo courtesy of CQ, Inc.

Much of the testing for the new coal cleaning techniques described here, took place at the Electric Power Research Institute's facility in Homer City, Pennsylvania.

Through the Department of Energy's Clean Coal Technology program, significant research has been performed to identify better ways to utilize our nation's most plentiful fuel supply — coal. This work has focused, however, primarily on combustion and post-combustion control techniques. It is the authors' long-held belief that the most cost-effective way to control sulfur emissions caused by the burning of coal is to remove sulfur before combustion, i.e. to truly "clean" the coal. This article describes some recent advances in coal cleaning technology that offer a highly cost-effective compliance solution for many electric utilities, while permitting the continued use of local coal supplies.

The coal cleaning technology discussed here is primarily an improvement on existing dense media cyclone technology in which there has been a modification of the media (the coal/magnetite mixture), the internal configuration of the cyclones (the separation equipment), and the media recovery circuits (the separation of clean coal from magnetite). These improved cleaning techniques allow many Appalachian-basin coals to be cleaned to sulfur levels of less than 1.2 pounds per million British thermal units (Btu), thus converting them to coals which meet compliance standards beyond the year 2000 — the deadline for Phase II of the Clean Air Act Amendments' SO_2 reduction provisions. Much of the testing of these techniques have been performed at CQ, Inc., the Electric Power Research Institute's (EPRI's) wholly owned subsidiary located in Homer City, Pennsylvania.

Sulfur in Coal and the Coal Cleaning Process

For convenience, raw coal can be viewed as a physical mixture of three components: organic material, rock, and pyrite. In raw coal, some particles are liberated, meaning that they constitute relatively pure components: pure organic material, rock, or pyrite. Other particles are locked, meaning that those particles contain two or more of the components bound together.

Each of the raw coal components contains sulfur. This gives rise to the three types of sulfur encountered in coal: organic (from organic material), sulfate (from rock) and pyritic (from pyrite). Upon combustion, each raw coal component produces ash. Pure organic material produces only a few percent ash, rock about 90 percent ash, and pyrite 67 percent.

Each of the raw coal components also has a characteristic specific gravity: organic material about 1.25, rock about 2.85, and pyrite about 5.2. Thus, raw coal can comprise a spectrum of specific gravities, a consequence of the differing specific gravities of the components, and the extent of component interlocking.

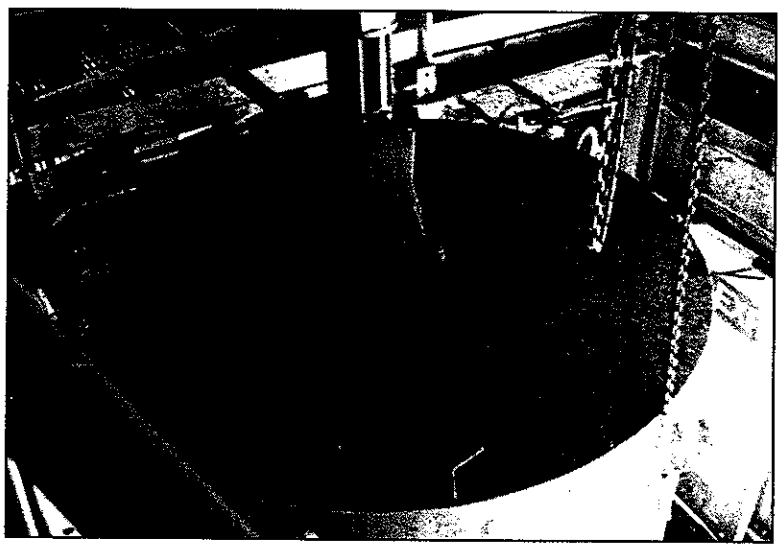


Photo courtesy of CQ, Inc.

When spun at high speed, modified cyclones act to accelerate separation of the clean coal and magnetite mixture from refuse material.

The low specific gravity of the organic material, compared to the higher specific gravities of the impurities — rock and pyrite — is the basis for their separation. Many coal cleaning processes operate on a float-sink basis; a principle akin to separating sand from saw dust by placing them in water. Particles of raw coal, lighter than some prechosen separating specific gravity, are collected as clean coal, and particles heavier than the chosen gravity are discarded as refuse.

Raw coal is usually sized into two or three size fractions before the specific gravity separations are made. This practice produces sharper separations at lower cost. Separations are usually made at specific gravities ranging between 1.40 and 1.65. This partitions approximately 90 percent of the organic material into the clean coal, 85 percent of the rock into the refuse, but only 60 percent of the pyrite into the refuse.

The poor rejection rate of pyrite to refuse is due to two factors. For coarse coal (larger than 1.5 inches), pyrite is often locked with the lighter (low specific gravity) organic material; thus, it is separated as clean coal. For finer coal (less than 1.5 inches), the methods of separation are inefficient and pyrite is misplaced into the clean coal.

Dense medium baths and dense medium cyclones are two widely used methods of cleaning raw coal thicker than .5 millimeters (mm). The "dense medium" is comprised of finely ground particles of the mineral magnetite suspended in water. The magnetite particles are quite fine, typically averaging 20 microns in diameter, so that they will readily stay suspended in the water.

Magnetite has a specific gravity of 5.2. Suspending fine particles of magnetite in water creates a pseudo-heavy liquid which has a specific gravity heavier than water alone. This is how separating "liquids" are created to the proper specific gravity for separating rock and pyrite from the organic material. The more magnetite added, the higher the specific gravity.

After cleaning, the magnetite is recovered from the coal (and refuse) for reuse. Ninety percent of the magnetite is collected by draining it away from the larger coal on a screen. The rest is rinsed off the coal (and refuse) with water, and the resulting dilute medium is sent through magnetic separators to recover the remaining 10 percent.

The Nature of a New Coal Cleaning Technology

In the Genesis coal cleaning process, coal to be cleaned is first divided into three size fractions. Beginning with the coarsest (largest) size fraction, coal is processed to:

- Recover an exceptionally low-ash, low-sulfur clean coal.
- Reject an exceptionally high-ash, high-sulfur refuse.
- Crush or grind the middling (remaining) material to the next smaller size fraction. Crushing and grinding liberate additional coal from refuse. This creates the potential to recover more clean coal, reject more refuse, and reduce the amount of middlings for reprocessing.
- Repeat steps 1, 2, and 3 until reaching the finest size fraction, where a two-product separation is made generating the final clean coal and refuse.

The process begins with a coarse coal fraction, typically 1.5 inches square, with a thickness of 0.5 mm, and continues to two finer fractions, 0.5 mm by 0.1 mm, and 0.1 mm by 0.015 mm. The material smaller than 0.015 mm, which

consists mostly of high ash clays, is discarded.

Critical to this processing strategy are:

- An efficient fine coal cleaning process which rejects pyritic sulfur.
- A method of removing high-ash fine clays. Clays otherwise retain moisture and cause handling problems.
- A method of agglomerating the fine clean coal resulting from the crushing and grinding.

Three key ingredients were brought together by Genesis to achieve efficient dense medium cleaning of coal thinner than .5 mm:

- Production of a new magnetite, much finer than conventional magnetite, from an industrial waste material.
- A modified cyclone and a method of operation which accelerates the separation of the extremely fine coal from associated refuse.
- Two methods of recovering the magnetite for reuse, one for each of the fine sizes of coal cleaned.

The total clean coal product — the combination of clean coal from all three cleaning circuits — has a distribution of sizes comparable to conventionally cleaned coal and is low in both sulfur and ash.

An increase in clean coal yield, due to liberation, is a significant advantage of this coal cleaning strategy over conventional coal cleaning. The increase in yield is about 10 percent.

The Impact on Clean Air Act Compliance

The application of the coal cleaning technology described above leads to two compliance coal products: Carefree Coal™ and Self Scrubbing Coal™. Carefree Coal is produced solely by the aggressive beneficiation (cleaning) technology described above, processing non-compliance eastern coal feedstocks.

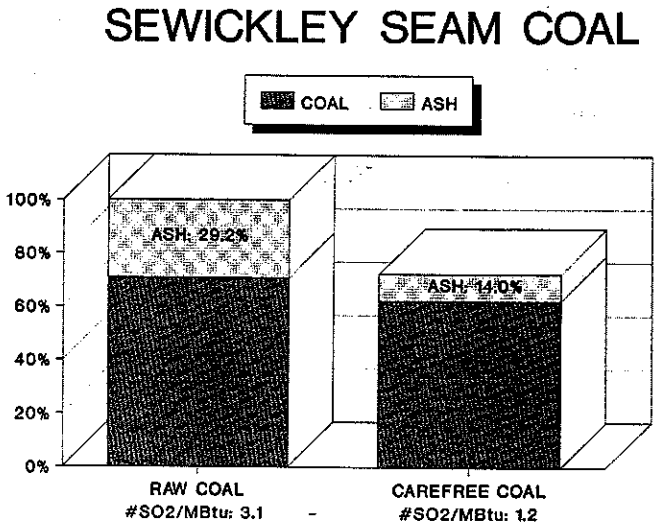
Many northern Appalachian and most southern Appalachian bituminous coals can be converted into compliance coals through aggressive beneficiation. The determining factors are:

- The organic sulfur value of the coal. Organic sulfur in the cleaned coal cannot exceed 0.87 percent. This assumes *complete* pyrite removal, and a Btu value characteristic of highly beneficiated coals from the region.
- The particle size required to achieve essentially complete liberation of pyrite from the coal. Liberation size can only be determined through a laboratory study.

Pennsylvania coals, for example, have an average organic sulfur content of 0.79 percent. This average is based on 205 raw coal *channel* samples representing over 80 percent of utility coal production in Pennsylvania. Other average analyses are: 14.8 percent ash, 1.73 percent pyritic sulfur, 2.52 percent total sulfur and 12,812 Btu per pound, on a moisture-free basis.

As a practical matter, an organic sulfur value of about 0.70 percent or less is required to produce a compliance coal through aggressive beneficiation; this assumes about 90 percent pyrite removal during coal cleaning. Many Pennsylvania coals are compliance coal candidates since three of the ten major seams in Pennsylvania have less organic sulfur than the 0.70 percent criterion, and six of the remaining seven coal seams have less than 0.92 percent organic sulfur. A percentage of coal mined from this second group may be compliance coal candidates, since the organic sulfur values reported for the seams are only averages. Production from all of these seams is substantial.

Northern Appalachian coals have an average organic sulfur content of 1.04 percent in the 1.30 float fraction,



based upon 227 coalbed samples collected from Maryland, Ohio, Pennsylvania, and northern West Virginia. Southern Appalachian coals have an average organic sulfur content of 0.74 percent in the 1.30 float fraction, based upon 35 coalbed samples collected from eastern Kentucky, Tennessee, southern West Virginia and Virginia. Alabama region coals have an average organic sulfur content of 0.70 percent in the 1.30 float fraction, based on ten samples. A substantial number of these coals can be cleaned to compliance sulfur levels. In contrast, coals from the Midwest region, which includes Illinois, Indiana, and western Kentucky, have an organic sulfur content of 1.74 percent in the 1.30 float fraction, based on 95 samples. These, and similar coals, which have an organic sulfur content too high to be made into Carefree Coal, can be readily made into Self Scrubbing Coal.

Self Scrubbing Coal, in addition to being highly

beneficiated like Carefree Coal, contains a patented mixture of sorbent and promoter which absorb sulfur dioxide in the boiler. For convenience in handling, these additives are agglomerated with the finest size of clean coal (.1 mm by .015 mm).

The Self Scrubbing process removes up to 80 percent of the sulfur remaining after aggressive beneficiation. The additives — dolomitic limestone, soda ash, and iron oxide — react with the sulfur dioxide formed during combustion. The reaction products which contain the sulfur are removed by the existing ash collection system.

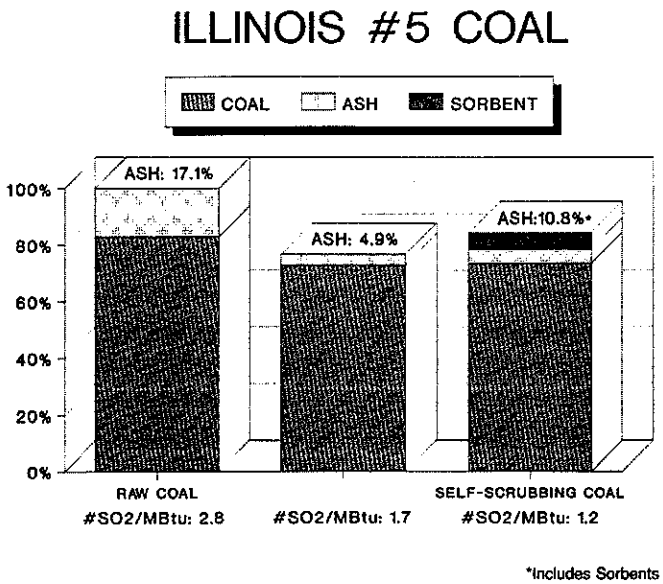
For coals which need slightly more sulfur removal than can be achieved by aggressive beneficiation, sulfur removal processes other than the Self Scrubbing additives can be used; for example, in-duct sorbent injection or gas co-firing could be utilized.

Economics of the New Technology

A cost comparison of two different methods of achieving compliance was performed based upon Sewickley Seam and Illinois No. 5 coals for which extensive washability and liberation data had been developed. The two compliance strategies compared were:

- Carefree Coal produced from Sewickley Seam Coal vs. conventional coal prepared from the same feedstock followed by flue gas desulfurization. Power generation was modeled after a Pennsylvania electric generating station.
- Self Scrubbing Coal produced from Illinois No. 5 Seam Coal vs. conventional coal prepared from the same feedstock followed by flue gas desulfurization. Power generation was modeled after a Midwest electric generating station.

The cost of producing electricity was determined by completing the following steps:



- Flowsheets were designed for both a conventional coal cleaning plant and the coal cleaning process described above.
- Material balances were calculated.
- Capital and operating costs were determined for both plants.
- The cost of transportation was computed.
- The cost of generating electricity was established by employing the EPRI power plant performance model — the Coal Quality Impact Model.
- For the conventional case, the cost of scrubbing was ascertained by using EPRI's Retrofit Flue Gas Desulfurization cost model.

Both examples showed a 10 to 25 percent cost advantage for the coal cleaning processes described above, compared to conventional coal cleaning followed by scrubbing.

Conclusions

The Clean Air Act Amendments of 1990 present several challenges to the electric power industry:

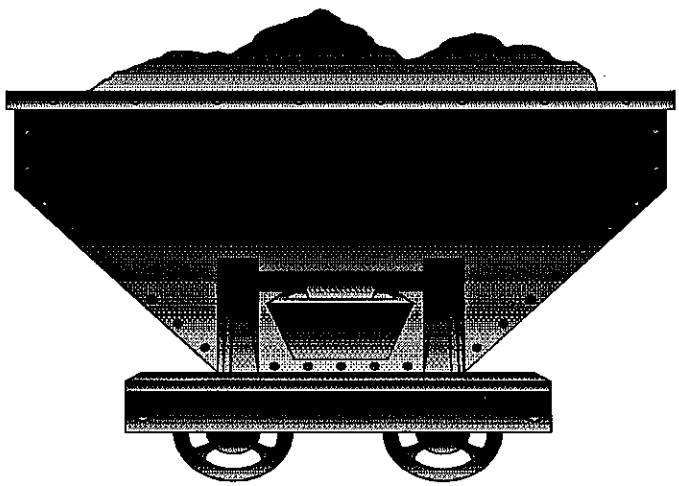
- Reduce SO_2 emissions to 2.5 pounds per million Btu by 1995 and to 1.2 pounds per million Btu by 2000.
- Continue to operate profitably by minimizing capital and operating costs, keeping consumer power rates down, and maximizing shareholder value.
- Maintain regional fuel supplies to avoid the adverse economic impact that would result from a loss of local mining jobs.
- Accomplish these objectives without affecting the operating performance of existing power generating capacity.
- Prevent the creation of any waste material which might affect environmental quality or require costly disposal methods.

The use of new coal cleaning technologies, such as the process described above, can make an important, cost-effective contribution to the industry's efforts to meet these challenges.

James Kelly Kindig is the executive vice president of technology for Genesis Research Corporation and Custom Coals International, and has been responsible for the development and commercialization of Carefree Coal and Self Scrubbing Coal. Prior to his work with Genesis, **Dr. Kindig** served as the vice president of technology for Integrated Carbons Corporation and Hazen Research, Inc. He has a Ph.D. in mineral preparation from The Pennsylvania State University, and holds numerous U.S. patents related to minerals beneficiation.

Robin L. Godfrey works in the finance group at Duquesne Light Company, and is also the vice president and secretary/treasurer of Custom Coals International—the joint venture between Duquesne Light and Genesis Research Corporation. Prior to working with Duquesne Light, **Ms. Godfrey** was a manager with Deloitte, Haskins & Sells. She holds a B.S. in business administration from The Pennsylvania State University and is a certified public accountant.

PRESS CLIPPINGS



NEWS

Duquesne Light
One Oxford Centre
301 Grant Street
Pittsburgh, PA 15279

CONTACT: Edward H. Sehon, Manager
Corporate Communications
(412) 393-6058 - (office)
(412) 571-0126 - (home)

FOR RELEASE:
Upon Receipt

PITTSBURGH, PA, September 12, 1991 -- The Department of Energy (DOE) today announced that a $76 million project submitted by Custom Coals International, a joint venture of Duquesne Ventures (a subsidiary of Duquesne Light Company) and Genesis Research, was one of several projects selected for funding in the DOE's Clean Coal Technology IV program. The demonstration project involves building a novel, 250 ton-per-hour coal processing plant in Greene County, PA to produce Self-Scrubbing Coal^{tm}.

Duquesne Light is the principal subsidiary of DQE (NYSE - DQE), an energy services holding company.

Custom Coals, which has overall project management responsibility, is joined on the project team by ICF Kaiser Engineers, which will design and construct the demonstration plant and CQ, Inc., which will test and operate the demonstration plant and manage the power plant field tests.

Both Governor Robert P. Casey and Lt. Governor Mark S. Singel, chairman of the Pennsylvania Energy Office, wrote letters to the U.S. Department of Energy in support of the Custom Coals' project. Governor Casey said he was pleased with DOE's decision, adding "Self-Scrubbing Coal technology offers many advantages in

meeting the sulfur dioxide limitations of the new federal Clean Air Act in a low cost, low risk and environmentally sound manner. This particular project could result not only in cleaner air but also could breathe new life into Pennsylvania's coal industry." Singel said the project "will help keep Pennsylvania coal a viable option for electric utilities as they move to conform with Clean Air Act amendments emission standards."

Wesley W. von Schack, Chairman and CEO of Duquesne Light Company, said: "The Clean Coal Technology IV grant provides a critically important step forward in demonstrating a technology that has the potential to make a significant contribution to finding cost effective solutions to difficult Clean Air Act compliance issues."

Congressman Austin J. Murphy, in whose district the plant will be located, commented: "It is tremendously gratifying to see a coal cleaning project that has the potential to do so much for Pennsylvania coal miners get funded."

Plant construction is expected to begin in late 1992 and the project will continue through 1995. Approximately 150 construction jobs and 25 to 30 plant operations and technical test jobs will be created to fulfill the demonstration commitment. The project will provide an opportunity to demonstrate the ability of the Self-Scrubbing Coal Technology to bring into compliance more than 150 million tons annually of bituminous coal that currently cannot meet emissions limits. This represents more than 20 percent of the bituminous coal burned in 50 MW or larger generating stations across the U.S. Continuing to burn this coal is

particularly important in saving coal mining jobs in the eastern and midwestern U.S.

To produce Self-Scrubbing Coal, run-of-mine coal is crushed, screened and cleaned with innovative dense-media cyclones to remove non-combustible material, including 90 percent of the pyritic sulfur in the coal. Then limestone-based additives are mixed with the cleaned coal -- additives that react to remove an additional 70-80 percent of the organic sulfur that remained with the clean coal.

Self-Scrubbing Coal technology, segments of which already have been tested at commercial scale, offers many advantages. It can reduce total sulfur 80-90 percent; it retains more than 90 percent of a coal's heating value; and the ability to handle the coal using traditional methods is improved. The technology is capable of using any bituminous coal as input, which allows utilities to continue using their existing coal sources, averting potential boiler derating and the economic dislocation caused by fuel switching.

During the demonstration project, coal from three U.S. coal seams (Sewickley, Pittsburgh and Illinois No. 5) will be utilized, representing a broad range of raw coal qualities. Duquesne Light's 570 MW Cheswick Plant near Pittsburgh and Richmond Power & Light's 60 MW Whitewater Valley Power Station in Richmond, Indiana, will test burn Self-Scrubbing Coal as a part of the project. Data collected during these test burns will validate the performance and measure the emissions reduction resulting from the use of this innovative coal in utility boilers.

* * *

DOE NEWS

NEWS MEDIA CONTACT:
Carole Beeman, 202/586-5810

FOR IMMEDIATE RELEASE
September 12, 1991

DOE ADDS NINE NEW CLEAN COAL TECHNOLOGY PROJECTS IN COMPLETING FOURTH ROUND OF NATIONWIDE COMPETITION

The U.S. Department of Energy (DOE) today named nine projects as its top choices in the fourth round of the multi-billion dollar Clean Coal Technology Program.

Acting Assistant Secretary for Fossil Energy Linda G. Stuntz announced the selections, calling the choices "key additions to a program that is preeminent among the coal initiatives of the President's National Energy Strategy."

The selected projects have a combined value of nearly $1.5 billion. Together with 33 other active ventures selected in earlier competitions, they bring the total government-industry investment in clean coal technology demonstrations to $4.6 billion, 60 percent of which is funded by private companies and states.

"Today's action moves us closer to our goal of having in place a full complement of 'showcase' demonstration plants that I believe represent the future new look of the nation's coal-fired power industry," said Energy Secretary James D. Watkins. "Many of the technologies virtually eliminate the major pollutants commonly associated with acid rain, and several offer the dual benefits of superior environmental performance coupled with more efficient, lower cost power generation. These are the technologies that can brighten our nation's energy future without compromising our commitment to a cleaner, healthier environment."

R-91-190

(MORE)

Included in the selection are three large-scale, high-efficiency electricity generating projects that DOE expects will help form the basis for a new generation of 21st century power plants. The technologies to be used in these projects, all of which rely on gasifying coal rather than burning it directly, are expected to produce as much as 25 percent more electricity from a given amount of coal than today's conventional coal-burning methods. In addition, they remove almost all of the pollutants known to cause acid rain.

The three account for nearly 75 percent of the nearly $568 million in federal funds to be shared by the nine selected projects, pending successful negotiations.

DOE had announced last January in issuing its call for proposals that it would give extra consideration to projects that increase the efficiency of coal-based energy systems. Boosting efficiency can not only reduce energy costs to consumers but is one of the principal ways for reducing gases that might contribute to global climate change.

"A common feature of virtually every new technology supported by the National Energy Strategy is its potential to more efficiently transform energy raw materials into the energy services we need. These clean coal technology projects reflect that commitment to greater energy efficiency in the generation of electricity," Watkins said.

Also included are four projects that will demonstrate high-performance pollution control devices that can be added to existing or new power stations. Each of these advanced devices will be capable of meeting the nation's more stringent sulfur and nitrogen pollutant controls required by the 1990 Clean Air Amendments.

Two other projects will demonstrate techniques to change coal into new, cleaner burning fuel forms that can be used in a variety of power generating, industrial or other energy applications.

Eight of the nine projects will employ U.S. technology, and all of the proposers would manufacture the major components of their technology in the U.S.

"The strong 'made-in-the-U.S.' aspect of these selections will add to America's competitive leadership, an advantage that will become increasingly important as worldwide demand for coal grows rapidly in the coming years," Watkins said. "The global environment will benefit if state-of-the-art U.S. technologies are marketed to the many nations planning to increase their use of coal."

DOE received 33 clean coal technology proposals last May. Since then, a team of nearly 100 federal officials, headed by an eight-member "source evaluation board," has been reviewing the proposals. The board scored such factors as technical readiness, environmental performance, improved efficiency and the proposer's commitment and capability to jointly finance the venture.

(MORE)

After reviewing the board's evaluation report, DOE's Deputy Assistant Secretary for Coal Technology, Jack S. Siegel, made the final selections.

"The projects we have selected are the best of perhaps our strongest slate yet of clean coal proposals," Stuntz said.

The new projects are located in eight states. In all, the Clean Coal Technology Program is sponsoring 42 ventures in 22 states.

The total federal assistance sought by the nine winning proposers exceeds the $568 million DOE has allotted for the competition. The department, however, expects to negotiate changes in certain projects, such as excluding certain ancillary hardware and reducing the length of operating times for certain projects, to bring costs down to the available level.

While definitive agreements for the newly-selected projects are being negotiated -- DOE has allotted a year to complete the talks -- preparations are underway for the fifth and final round of the Clean Coal Technology Program.

DOE said at today's press briefing that it will hold public meetings in Cheyenne, WY, and Louisville, KY, in October and November, to obtain public comment on its plans for the fifth round. Current plans are to begin the fifth round by March 1, 1992.

A listing of the nine new projects is attached.

-DOE-

R-91-190

CLEAN COAL TECHNOLOGY ROUND 4
-- Selected Projects --

HIGH EFFICIENCY POWER GENERATING PROJECTS

Proposer: TAMCO Power Partners
Williamsport, PA

Title: Toms Creek IGCC Demonstration Project

Anticipated Site: Coeburn, VA Total Estimated Cost: $219.1 million*
DOE Share: 49.7%

TAMCO Power Partners, a partnership of Tampella Power Corp. and Coastal Power Production Co., in conjunction with participants Stone & Webster Engineering, and the Institute of Gas Technology, will conduct the demonstration project. The application for the demonstration plant is a new power plant facility. The proposed site is at an existing coal mine near Coeburn in Wise County, Virginia.

The technology to be demonstrated is an integrated gasification combined cycle (IGCC) process. A total 107 MW of power will be delivered to the electric grid at the completion of the project. The plant will demonstrate improved coal-to-power efficiencies and reduced costs compared to commercially available systems. In addition, significant reductions in SO2 and NOx emissions will be accomplished.

Proposer: Sierra Pacific Power Company
Reno, NV

Title: Pinon Pine IGCC Power Project

Anticipated Site: Western Nevada Total Estimated Cost: $340.7 million*
DOE Share: 50%

Sierra Pacific Power Company (SPPC) is proposing a new 80 MW Integrated Gasification Combined Cycle (IGCC) plant in western Nevada for the generation of electrical power. To build the facility, SPPC will enter into a contract with Foster Wheeler USA Corporation. The MW Kellogg Company will be the subcontractor which will provide the design for the KRW fluidized bed gasification process.

The objective of the project is to demonstrate that integrated coal gasification combined cycle power plants can be built at capital costs and thermal efficiencies which significantly reduce electric power costs relative to conventional technologies. The project will also demonstrate the effectiveness of hot gas cleanup in achieving a negligible environmental impact for low sulfur western coals.

Proposer: Wabash River Coal Gasification Repowering Project Joint Venture
Houston, TX

Title: Wabash River Coal Gasification Repowering Project

Anticipated Site: West Terre Haute, IN Total Estimated Cost: $591.9 million*
DOE Share: 41%

The Wabash River Coal Gasification Repowering Project, a joint venture of Destec Energy, Inc. of Houston, Texas and PSI Energy, Inc. of Plainfield, Indiana, is a nominal 265 MW (net) integrated gasification combined cycle power plant. The project will be used to repower one of six units at PSI's Wabash River Generating Station in West Terre Haute, Indiana.

The objective of this project is to show that a commercial scale IGCC system can be economically and environmentally effective in the utility market place. The project will produce no solid or liquid wastes.

ADVANCED, HIGH PERFORMANCE POLLUTION CONTROL TECHNOLOGIES

Proposer: Union Carbide Chemicals and Plastics Company Inc.
Danbury, CT

Title: Demonstration of the Union Carbide CANSOLV Process at the ALCOA Corporation Warrick Power Plant

Anticipated Site: Newburgh, IN Total Estimated Cost: $32.7 million*
DOE Share: 50%

Union Carbide Chemicals and Plastics Company Inc. (UCC&P) proposes to design, build and operate a 75 MW "CANSOLV" regenerable flue gas desulfurization system at the ALCOA Generating Corporation Warrick Power Plant near Newburgh, Indiana. The process is designed to operate as an in-duct scrubber system. The retrofit scrubber facility will be installed in one of two flue gas ducts for an existing 150 MW boiler.

The goal of this demonstration is to achieve at least 99% SO2 removal while providing a commercially viable alternative to throw-away scrubbers for both electric utility and industrial coal users.

Proposer: Custom Coals International
Pittsburgh, PA

Title: Self-Scrubbing Coal: An Integrated Approach to Clean Air

Anticipated Site: Greensboro, PA
Springdale, PA
Richmond, IN

Total Estimated Cost: $76.1 million*
DOE Share: 50%

Custom Coals International is a joint venture between Duquesne Ventures (a subsidiary of Duquesne Light Co.) and Genesis Research Corporation. Included in the proposed demonstration are team members CQ Inc. and ICF Kaiser Engineers. The "Self-Scrubbing Coal" technology involves the integration of advanced physical coal cleaning with coal/sorbent reconstitution techniques to produce a utility or large industrial fuel which emits less than 1.2 lb SO2/MMBtu. A coal which can meet this SO2 limit with the proposer's advanced coal cleaning technology is referred to as "Carefree Coal."

The objective of the demonstration is to provide all of the necessary data to support near-term erection of 750-1000 tph Carefree and Self-Scrubbing Coal producing plants.

Proposer: New York State Electric & Gas Corporation
Binghampton, NY

Title: Milliken Clean Coal Technology Demonstration Project

Anticipated Site: Lansing, NY

Total Estimated Cost: $158.6 million*
DOE Share: 40.7%

The Milliken Clean Coal Demonstration Project proposed by New York State Electric & Gas will demonstrate a combination of cost effective emission reduction and efficiency improvement technologies which will allow utilities to comply with the Clean Air Act Amendments of 1990. Reduction of sulfur dioxide and nitrogen oxides will be demonstrated at reduced cost with minimal impact on station efficiency or heat rate. Project team members include New York State Electric & Gas Corporation, Consolidation Coal Company, Saarberg-Holter-Umwelttechnik GMBH (S-H-U) and Stebbins Engineering and Manufacturing Co.

The objectives of this project are 98% SO2 removal efficiency using limestone while burning high sulfur coal, NOx emission reduction using selective noncatalytic reduction technology in conjunction with combustion modifications, production of marketable byproducts (commercial grade gypsum, calcium chloride and fly ash), zero waste water discharge, maximum station efficiency using the heat pipe air heater system, low power consuming scrubber system, and the space saving design of the Stebbins scrubber module.

Proposer: Tennessee Valley Authority
Knoxville, TN

Title: Micronized Coal Reburning Demonstration for NOX Control on a 175 MWe Wall-Fired Unit

Anticipated Site: Paducah, KY Total Estimated Cost: $7.3 million*
DOE Share: 48%

This project is proposed by the Tennessee Valley Authority, joined by MicroFuel Corporation, R-C Environmental Services & Technologies and Duke/Fluor Daniel. The technology is the reduction of NOx emissions by the retrofit of coal reburning to a pulverized coal, wall-fired boiler on an existing 175 MWe wall-fired unit at the Shawnee Fossil Plant near Paducah, Kentucky.

The objective of the demonstration is to reduce NOx emissions by 50 to 60%, using the current source for fuel. Also, the additional mill capacity would be advantageous if a decision were made to employ a low-sulfur Powder River Basin coal, since the lower heating value would result in a capacity loss at the existing mills. Such a substitution could be effective in reducing SO2 levels.

NEW FUEL FORMS OF COAL

Proposer: ThermoChem, Inc.
Columbia, MD

Title: Demonstration of Pulse Combustion in an Application for Steam Gasification of Coal

Anticipated Site: Springfield, OR Total Estimated Cost: $37.3 million*
DOE Share: 50%

ThermoChem has proposed a demonstration of MTCI's pulse combustor in an application for steam gasification of coal. This gasification process will produce a medium Btu-content fuel gas from subbituminous coal at Weyerhauser Paper Company's Containerboard Division mill in Springfield, Oregon. The fuel gas and by-product steam produced by this demonstration unit will be used in the mill to offset use of existing hog-fuel boilers.

The objective of the ThermoChem project is the demonstration of a 429 ton per day (as-received coal) novel coal gasification unit.

Proposer: Cordero Mining Co.
Gillette, WY

Title: Cordero Coal Upgrading Demonstration Project

Anticipated Site: Gillette, WY Total Estimated Cost: $34.3 million*
DOE Share: 50%

The proposer, Cordero Mining Company, has assembled an interdisciplinary project team composed of Carbontech, the technology owner; Stone & Webster, the project engineering firm; and Dairyland Power, the utility host. The purpose of the proposed technology is to use the Carbontech Syncoal Process to upgrade high moisture, low-sulfur, low-rank coals. This upgraded fuel could be used in power plants designed to burn higher Btu coals, and as a low sulfur fuel for future power generation and industrial facilities.

The objective of this demonstration is to build and operate a pre-commercial size coal upgrading plant (250,000 tons/year) using the Carbontech technology.

* Total estimated costs reflect figures provided by the proposers in the Public Abstracts accompanying the proposals. These costs are subject to negotiation.

UPDATE

Chernobyl update available from USCEA

A briefing book just issued by the U.S. Council for Energy Awareness explores Chernobyl and its aftermath. The 1986 accident, which has become entangled in the political and social upheaval in the Soviet Union, also has opened a new level of East-West cooperation on nuclear energy.

The book summarizes the accident and its consequences, the technical differences between U.S. and Soviet plants, and international activities to help upgrade Soviet and Eastern European nuclear plants and operations since 1986. Also included is a list of experts who are available to discuss Chernobyl, U.S. and Soviet nuclear technologies, and radiation and health effects.

For information, contact Cathy Steele Roche, Steve Unglesbee or Scott Peters at 202-293-0770.

Contract signed for FGD systems; direct result of new clean air law

The first major design, supply, and construction contracts resulting from 1990 amendments to the Clean Air Act have been signed by the Allegheny Power System and General Electric Environmental Systems.

The APS Companies (Monongahela Power Co., Potomac Edison Co., and West Penn Power Co.) awarded the $83+ million contract to GE to design, supply, and erect three single-vessel flue gas desulfurization absorber systems, auxiliary equipment, and a three-flue, 1000-ft chimney at their jointly owned 1920-MW Harrison power station near Clarksburg, W.V.

The scrubbers are part of the APS Companies' strategy to comply with Phase I acid rain provisions of the amendments. Construction of the scrubbers is expected to start in the fall of 1991, and will be managed by a subsidiary of United Engineers & Constructors, Inc.

Estimated cost for the three Harrison scrubbers is $725 million. The scrubbers, which remove a minimum of 98% of SO_2 emissions, will allow the continued use of local high-sulfur coal.

EPRI offers boiler maintenance software and support

The Electric Power Research Institute (EPRI) is offering its Boiler Maintenance Workstation (BMW), designed to assist plant engineers and technicians in determining effective corrective maintenance actions and anticipating future component replacement requirements. The software documents and displays the detailed maintenance and performance history of a specific boiler.

BMW is designed to support the entire boiler maintenance life cycle. EPRI and Karta Technology offer boiler consulting and BMW software support services.

The user-friendly interface guides personnel through six display and analysis modules, including Tube Condition, which stores and displays detailed inspection data and projects reinspection/replacement timing; Boiler Graphics, which imports scaled heat exchanger CAD drawings and displays material, repair, and inspection information; and Heatrate, which analyzes boiler operating test data and tracks performance.

Information may be obtained from John Scheibel, EPRI Program Manager (415-855-2850).

Joint venture introduces new 'clean' coal product

A new technology combining advanced coal cleaning and combustion techniques may provide another option for coal-burning electric utilities to comply with new clean air standards. The new technology, "Self-Scrubbing Coal," will be marketed by Custom Coals International, a joint venture formed by Duquesne Light Co., Pittsburgh, and Genesis Research Corp., Carefree, Ariz.

The new fuel involves the production of a marble-size, pelletized coal product from which more than 90% of the pyritic sulfur has been removed in a specially designed coal preparation plant. Additives combined with the coal react during combustion to capture up to 80% of the remaining organic sulfur.

Duquesne Light and Genesis have spent six years developing the technology. Commercial-scale testing recently was completed at the CQ, Inc. coal quality facility, an EPRI subsidiary, in Homer City, Pa.

2nd tire burning test begins at IP power plant

Illinois Power's Baldwin power station is test-burning 300 tons of shredded used tires in one of the plant's three boilers in a test program to find a practical way to rid the state of some of the 11 million waste tires it generates annually. Landfill space is shrinking rapidly, and tires left uncovered in above-ground piles provide an ideal breeding ground for disease-carrying mosquitoes.

Illinois Power is participating in a program being conducted by the Illinois Department of Energy and Natural Resources (ENR), in which the agency is providing a grant of $50,000 to cover the cost of the tires, shredding them to a one-inch size, transporting them to the plant and monitoring the test. Illinois Power is providing the equipment and manpower for the program.

The test co-fires a mixture of 2% tire-derived fuel and 98% coal in one of the units at Baldwin, which was chosen because it has cyclone-type boilers.

HERALD-Standard

UNIONTOWN, PA., MONDAY, JUNE 10, 1991

Coal-cleaning plant

Greene County may get multi-million-dollar project

By C.M. MORTIMER
Herald-Standard Staff Writer

An innovative coal-cleaning demonstration plant may be built in Greene County if the multi-million dollar project is funded under the government's Clean Coal Technology Program.

The experiment involves involves building a 250-ton-an-hour coal cleaning plant to produce self-scrubbing coal, designed as an alternative for utility companies faced with sulfur emission reduction challenges posed by requirements of the 1990 Clean Air Act.

The project is being developed by Custom Coals International, a joint effort between Duquesne Ventures, a subsidiary of Duquesne Light Co., and Genesis Research Corp. of Carefree, Arizona.

Total cost of the project is estimated at $76,077,309, which if approved would be split between the Department of Energy and the private developers.

Custom Coals International is one of 31 companies vying for a share of nearly $570 million in federal funds to demonstrate new ways to burn coal cleanly.

The combined government-industry value of the projects spread over 17 states is more than $6.5 billion, with about $2.3 billion requested in federal funds, according to the Department of Energy.

The Clean Coal Technology Program is a cooperative effort between the federal government and industry. It is testing advanced methods for cleaning pollutants from coal in near-commercial scale, showcase projects.

Donald A. Shirer, project manager for Custom Coals International, said the experiment involves the construction of a new preparation facility near Greensboro, in the vicinity of Duquesne Light Co.'s Warwick Mine and preparation facilities. He also noted the existing preparation plant would not be affected.

> **"We'll probably advertise bids for the coal...we're leaving all the doors open."**
>
> — Donald A. Shirer
> Custom Coals International

He added that the project involves the mining of coal from three different coal seams, including both the Sewickley and Pittsburgh seams.

Shirer said it hasn't been determined which specific mines which would supply the coal, but noted the Warwick facility mines the Sewickley seam and Consolidation Coal Co.'s Dilworth Mine uses a lot of Pittsburgh seam.

"We'll probably advertise bids for the coal...we're leaving all the doors open," said Shirer.

He also said a temporary staff would be needed if the project were approved, and significant employment could be realized if the project was a success.

"Because this is a demonstration, it won't be permanent right now. However, if it is a success it could be maintained commercially," said Shirer.

Shirer said he expected to know by December whether the government has selected the project for funding. If approved, he estimated the project would take another 45 months to develop before it came on line in 1995.

He noted that segments of self-scrubbing coal technologies have already been tested at commercial scale, and depends mainly on conventional, proven technology.

(See GREENE on Page A-2)

Greene may get coal plant

(Continued from Page A-1)

According to a summary provided to the DOE, self-scrubbing coal integrates pre-combustion and combustion sulfur reductions in reducing emissions.

Its breakthrough comes from three innovative aspects of the cleaning process and its unique magnetite production and recovery process.

Shirer observed that because self-scrubbing coal is so firmly grounded in proven technology, it is an economical, low-risk, conservative approach to meeting emissions limits that should appeal to the utility industry.

He explained that two forms of coal produced during the demonstration, with and without a limestone additive, will be tested by commercial power plants using coal mined from the three targeted coal seams.

The coal will be burned at Duquesne Light Co.'s 570-megawatt Cheswick Plant near Pittsburgh, and the 60-megawatt Whitewater Valley Power Station in Richmond, Ind.

Data collected during these test burns will validate the performance and measure the emissions reduction of the innovative coal forms in utility boilers.

Shirer noted that if the process is successful, an estimated 164 million tons annually of bituminous coal that ordinarily would not meet emissions limits through conventional coal cleaning methods would be brought into compliance.

This represents over 38 percent of the bituminous coal burned in 50-megawatt or larger generating stations across the country.

Self-scrubbing coal burns cleaner

A new technology that combines advanced coal cleaning and combustion techniques may provide another option for coal-burning electric utilities trying to comply with new federal clean air standards.

The technology was announced by Custom Coals International (CCI), a joint venture formed by Duquesne Light Co., headquartered in Pittsburgh, Pa., and Genesis Research Corp., located in Carefree, Ariz.

The technology will allow utilities to reduce sulfur dioxide and nitrous oxide emissions to levels well within those specified by Congress in the Clean Air Act Amendments of 1990. Officials said the technology can help power plants achieve compliance at a lower cost than existing alternatives, such as installing expensive flue gas desulfurization equipment, known as scrubbers, or switching to low-sulfur coal.

"Because of its ability to eliminate a high percentage of the sulfur from virtually any coal, the technology will allow a utility to use locally mined coal, thus preserving local mining jobs that otherwise would be lost by switching to low-sulfur coal mined elsewhere," said Wesley W. von Schack, chairman and chief executive officer of Duquesne Light Co.

The technology, to be marketed under the trade name Self-Scrubbing Coal, involves the production of a marble-size, pelletized coal product from which more than 90% of the pyritic, or free, sulfur has been removed in a coal preparation plant of unique design. Additives that have been combined with the coal react during the combustion process to capture 70% to 80% of the remaining organic sulfur. CCI President Sheldon M. Wool said the technology should be particularly appropriate for many of the country's 1,100 existing, non-scrubbed, coal-fired boilers. Officials said that between 70% to 90% of the total sulfur content of many coals can be removed.

The handling, storage and combustion properties of the weather-resistant pellets are comparable to those of conventional coal, so that no major modifications to utility boilers are required.

Duquesne Light and Genesis have spent more than six years developing the technology. Commercial-scale testing was completed recently at the Electric Power Research Institute's coal quality facility in Homer City, Pa.

According to von Schack, CCI will soon be extending invitations to utilities to examine the results of the commercial-scale testing. In addition, by mid-1991 CCI will make available quantities of the fuel for testing in utilities' boilers. □

Stream sealing keeps mines dry

Methods to identify and subsequently seal surface water loss zones in stream channels were tested by U.S. Bureau of Mines researchers at Staub Run, located near Frostburg, Md., and Guyses Run, near Fairmont, W.Va.

Conventional stream gauging was conducted to establish discharge patterns before and after stream sealing. Discharge was measured using a portable flowmeter equipped with an electromagnetic sensor. Electromagnetic conductivity surveys were performed within the stream channel to identify zones of increased water saturation as deep as 50 feet.

Using this information, an experimental grouting procedure was applied by injecting an expandable polyurethane grout to a depth less than one meter into the alluvial streambed over a 600-foot section of the stream channel. Before grouting, the study section exhibited a 6-gallon-per-second flow loss. After the first-phase grouting, the loss was reduced to 3.5 gallons per second. A second-phase grouting reduced the losses to only 0.8 gallons per second.

Benefits of the stream sealing technique include: reduced or eliminated surface stream infiltration into underground mines, with minimal disturbances to the environment; reduced sealing time; and reduced water pollution from abandoned mine workings. □

Speedy flotation reduces cells

A Fast Air-injected hydrocyclone Shallow Tank (FAST) flotation system is being researched by the U.S. Bureau of Mines in Tuscaloosa, Ala.

Conventional flotation kinetics are a compromise between two conflicting requirements—the need for an agitated zone for rapid bubble-particle collision and a quiescent zone for bubble-pulp separation. The Bureau of Mines has designed a flotation system in which bubble-particle collision and bubble separation are carried out in two unit operations.

A bubble slurry and an ore slurry are mixed at a high rate in a modified air-injected hydrocyclone for rapid bubble-particle collision. The mixture is then fed into a unit specially designed for rapid separation of the bubbles from the pulp. In laboratory work, the separating unit was a tall, cylindrical tank. The fast system recovered copper ore much more quickly and as effectively during testing as a conventional flotation system. □

Utilities Choose Between Early Compliance and New Technologies

By Leonard S. Greenberger

The race is on to meet the requirements of the Clean Air Act amendments signed into law last year. Although the Environmental Protection Agency (EPA) has yet to announce important rules concerning permitting procedures and the acid rain allowance trading program, utilities do know this: By 1995, 107 of the nation's dirtiest power plants will have to meet the new, strict Phase One emissions standards. And by 2000, the rest of the industry will have to reduce sulfur dioxide (SO_2) emissions by a total of ten million tons, and nitrogen oxide (NOx) emissions by two million tons.

These deadlines would seem to demand that utilities announce their compliance strategies soon. Indeed, some already have. But several promising technologies are surfacing around the country that might substantially reduce the cost of compliance, if utilities can only wait. For utility planners who must make decisions based on what they know today but also with an eye on what tomorrow may bring, the question has become: Will more benefits accrue to those who play the tortoise in this race, or to those who play the hare?

As it turns out, each will probably gain, and each will also lose. For the hares, the allowance trading market acts as a carrot, luring them in the direction of quick compliance. Most analysts agree that the bulk of potential profits from swapping allowances for cash will be available early in the program. That means utilities who want to get into the game will have to start over-controlling now. With current estimates placing the nationwide cost of compliance at $11 billion over the next four years and $25 billion by 2000, many utilities might like the idea of retrieving millions from the allowance market.

During a four-month long test, Florida Power and Light's Sanford power plant, located near Orlando, will burn a new bitumen-based fuel as a substititute for oil.

For those companies with Phase One units, the 1995 deadline serves as a stick. After all, 1995 is less than four years away, and time is a luxury they cannot afford. But even these companies are keeping their options open when it comes to Phase Two strategies. Cyndi Shoop, a spokeswoman for Potomac Edison, said that while her company already has announced tentative plans to bring its Phase One Harrison power station into compliance through more scrubbing, it is waiting before committing to any Phase Two plans. The potential for new technologies was "taken into consideration when the studies were done, but in the interests of compliance, we wanted to move quickly, with the least cost to the customers and the company," she said. "If there are new scrubbing technologies, I'm sure they will be considered for Phase Two of the project. We're not saying we can't change our minds."

As reported in the last FORTNIGHTLY (p. 44), General Public Utilities (GPU) Corporation has released its own $675 million capital investment plan. The company has pretty much committed itself to fuel switching, wet flue gas desulfurization (FGD) scrubbers, and low NOx burners for its three Phase One plants. But company spokesman Ray Dotter echoed Shoop when he said that GPU will keep all its options open when it comes to any further plans. "Tomorrow a new technology might be introduced that makes scrubbing much easier and less expensive," Dotter said. He added that the company will keep an eye on all new technologies as they become available.

Those new technologies are coming fast and furious now that the Clean Air Act amendments have placed a

premium on efficient and cost-effective emissions control. So for those planners who are forced to keep one eye on the balance sheet and another on the trade journals, what follows is a brief synopsis of what rewards might await those with the patience of a tortoise. But both tortoises and hares must exercise caution, as most of these technologies are still in the developmental stage.

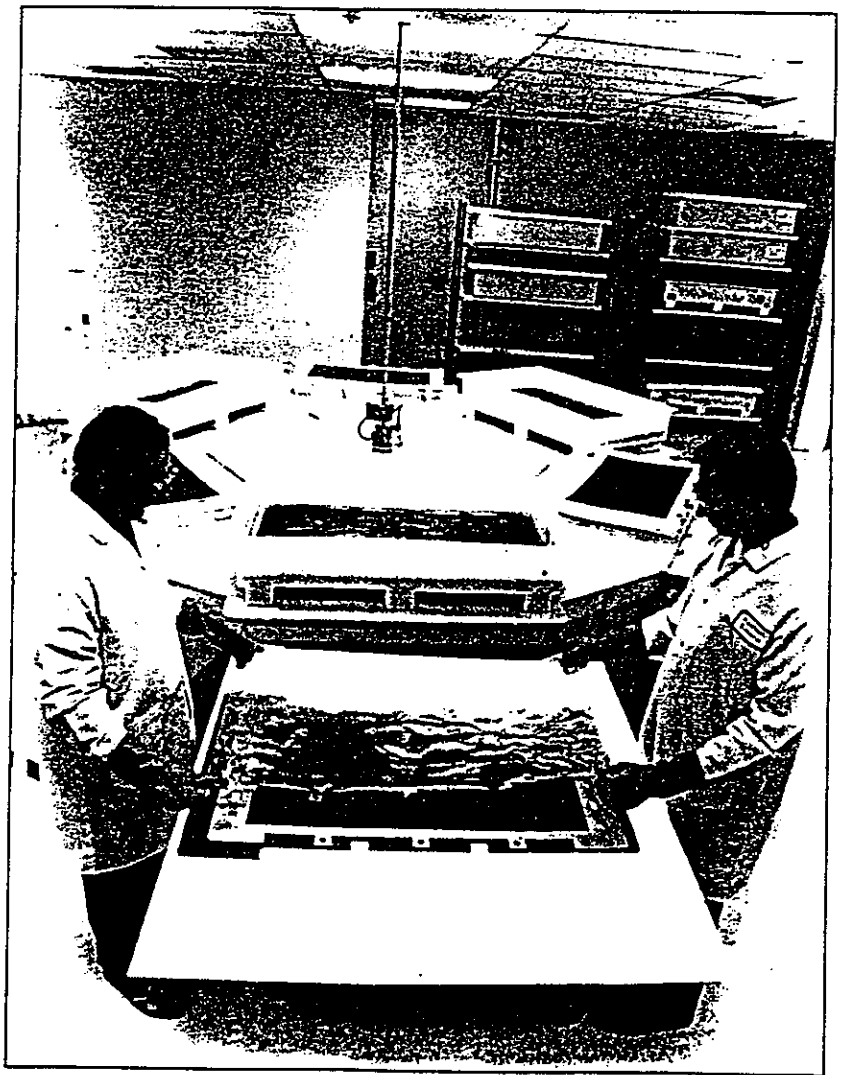
Orimulsion and the Soxal Process

Not far from Disneyworld and all that is tourism in Orlando, Florida, stands Florida Power & Light (FPL) Company's Sanford power plant. There, in the shadow of EPCOT's geodesic dome and Cinderella's castle, FPL and Allied-Signal, Inc., of New Jersey will test a new scrubbing technique known as the Soxal process. If all goes well during the four-month test, which has been delayed according to FPL spokesman Ray Golden, the Soxal process should not only remove the majority of SO_2 from the plant's emissions, but also virtually eliminate the gypsum sludge associated with most scrubbing techniques.

The plant will also burn a new type of fuel known as Orimulsion, a trade name for a liquid fuel combination of bitumen and water, a heavy hydrocarbon. Manufactured in Venezuela, Orimulsion has already been used overseas as a cheap substitute for oil. Golden said that the test will determine how the burner tips and other parts of the Sanford unit react to the new fuel. Unfortunately, during preliminary tests, the Orimulsion delivered a higher opacity than expected, prompting the delay while the companies seek state permission to run the test at higher opacity levels. FPL already knew that Orimulsion burns no cleaner than oil. It is only a cheaper alternative. So the company is looking at a host of possible emission control technologies, the most exotic being Allied-Signal's new scrubbing technique.

The Soxal process first removes the sulfur compounds in the flue gas through a high-efficiency, sodium-based scrubbing system. Instead of being combined with a mitigating agent, the sulfur is directed to a processing plant where specially designed bipolar and monopolar "membranes" segregate the spent liquid into its base and acid components. The base compounds are returned to the flue gas to aid in further scrubbing, while the acid compounds continue on in the process to a "stripper." The stripper separates the reclaimed acid effluent into two reusable sulfur products, rather than the gypsum sludge that must be landfilled. The two products, SO_2 and sodium sulfate, can be marketed to a variety of outside industries, including phosphate-fertilizer manufacturers and detergent producers.

James Molzon, general manager of Aquatech Systems, an Allied-Signal subsidiary, sees a lot of promise in the new technology. "If the FPL test burn is as successful as both companies anticipate, full-scale applications will be the next step," he said. "Utilities can then shift to the lower-cost fuels so plentiful in North America such as Orimulsion, other bitumens, and high-sulfur coals." If Molzon is right, this will be a substantial reward for the patience of those utilities that choose to run as tortoises.



Workers carefully lift a new membrane that has been developed to treat industrial plant waste in the fight against acid rain. The membranes separate the wastes into acids and bases, which can then be converted into useful chemicals.

Self-scrubbing Coal

A new, recently developed technology may allow utilities to meet the stringent new clean air standards without resorting to scrubbers at all. Last month, Custom Coals International (CCI), a joint venture formed by Duquesne Light Company of Pittsburgh and the Genesis Research Corporation of Carefree, Arizona, announced the development of a new technology that combines advanced coal-cleaning and combustion techniques to produce a very clean-burning, ready-to-go coal.

The company plans to market the technol-

ogy under the trade name "Self-scrubbing Coal." The process involves the production of a marble-sized, pelletized coal product from which more than 90 percent of the pyritic, or "free," sulfur has been removed. Additives combined with the coal as it is produced react during the combustion process to capture 70 to 80 percent of the remaining organic sulfur. Because the handling, storage, and combustion properties of the pellets are comparable to those of conventional coal, CCI said that existing utility boilers need not undergo any major modifications to accept them.

The new coal's primary advantage is the money that it saves companies because they do not have to go out and purchase scrubbers, whether advanced or not. It also allows utilities to continue to use higher-sulfur coal from mines nearby, which eliminates the need to pay the high transport costs often associated with switching to lower-sulfur coal and preserves local mining jobs.

CCI said that commercial-scale testing is now complete and that it expects the technology to be available for commercial application by 1992. "We plan to have it available in time for utilities to consider it as a major option in the mix of strategies available to meet the clean air compliance schedules," said CCI President Sheldon Wool.

Natural Gas "Reburn" Technology

In January, Ohio Edison Company, EPA, and other industry groups and governmental agencies announced that preliminary tests run at Ohio Edison's Niles power plant near Warren, Ohio, had reduced the plant's overall NOx emissions by over 50 percent. The tests, each lasting from eight to ten hours, were designed to study the effectiveness of a new combustion technology known as "reburning."

The technology creates a second combustion, or reburn zone, downstream from the main burners in a boiler. Combustion gases created during the initial burn move to the reburn zone, where a secondary fuel is injected — in this case, natural gas. The injection of the secondary fuel creates a "fuel-rich" zone in which nitrogen oxides formed in the initial burn are converted to molecular nitrogen and water vapor. Water vapor is obviously not harmful to the atmosphere, and molecular nitrogen already makes up nearly 80 percent of the air we breathe. The process provides a small side benefit as well: The use of clean-burning natural gas as a secondary fuel reduces the amount of coal needed, cutting down on SO_2 emissions.

EPA said that the goal of the new technology is to reduce emissions from older, high NOx-emitting boilers to levels comparable to new, state-of-the-art boilers. But Robert Hall, chief of EPA's combustion research branch and the project's manager, warned that more testing must be done to verify and enhance the procedure. "Further tests are needed to confirm that this technology can be used for extended periods, under various operating conditions, and without significant adverse side effects," Hall said. "But the preliminary results are promising."

New Emissions Monitoring Equipment and Dry Scrubbing

Determining a compliance strategy and choosing the technology to conduct it is only one step in the emissions-reduction process. The federal government will also want to know how things are going and to receive periodic reports. Toward that end, Environmental Elements Corporation (EEC) of Baltimore has announced the introduction of a new emissions monitoring system called CEM, for continuous emission monitoring, which can be used with all air pollution control equipment.

The CEM system can monitor up to seven different gas emissions including ammonia and hydrochloric acid with a single analyzer. Although the system seems perfectly suited for complying with the Clean Air Act amendments' monitoring guidelines, John Lalley, EEC's director of investment relations and corporate communications, said that the company originally developed the technology for municipalities involved in hazardous and solid waste incineration. "It's something we added to our repertoire at the request of a customer in the municipal solid waste business," he said. EEC decided to market the equipment to the utility industry only after it became clear that some form of clean air legislation was inevitable.

In addition to the federal requirements, the company claims that the system meets the most stringent state reporting standards. Lalley said the system will cost anywhere from $300,000 to $3 million, depending on the number of gases a company wants to monitor and the number of stacks equipped. One important feature for utilities looking to comply early is that the system can be installed in less than a year.

EEC has also entered the field of emissions control in the form of a new process that the company calls "dry" scrubbing. The system is based on an FGD process that uses the circulating fluid bed concept, and according to EEC is less costly than wet scrubbing. The company estimates capital costs for complete installation at $60 to $100 per kilowatt. And because the system can be installed between existing boilers and precipitators, many previously unretrofitable generating plants can now be accommodated.

The dry system meets or exceeds the SO_2 removal efficiencies of limestone wet scrubbers, the company asserts, and is currently performing at a 97 percent removal rate on coal with a sulfur content of up to 6 percent. Unlike some of the other technologies discussed, dry scrubbing has been in commercial operation for three years at three coal-fired boilers in Germany. In fact, the monitoring equipment and the dry scrubbing advances are both German innovations. EEC markets them in North America for two different German companies.

Leonard S. Greenberger is an associate editor of the FORTNIGHTLY.

CCI TO SELL COMPLIANCE COAL, PROCESS BY 1992

A Pittsburgh-based company, combining advanced coal-cleaning and combustion techniques, will soon be marketing a brand of clean coal and the process that manufactures it.

Custom Coals International (CCI), a joint venture between Duquesne Light Co. an Genesis Research Corp. of Carefree, Ariz., has been working on its clean-burning coal technology for the past six years. The product: a clean fuel to be peddled under the name Carefree coal.

This is CCI's second clean coal, a sister to Self-Scrubbing coal, the company's marble-sized, pelletized product that was introduced in early February (C&ST 2/18).

Both processes liberate clean coal after it is separated from pollutants. The coal is then channeled through a combination of proprietary advanced cleaning steps and in-boiler toxic gas reduction.

In Carefree coal, about 90% of the pyritic sulfur and ash are removed

(Continued on page 7)

CAREFREE COAL TO ENTER MARKET ... (FROM PAGE 1)

through a CCI system based on a dense media cycloning process that involves crushing, coarse cleaning and selective grinding. J. Kelly Kindig, CCI vice president of technology, notes that with SO_2-capturing additives, this high- Btu, low-ash bituminous coal can limit total SO_2 emissions to 1.2 lbs/mmBtu, a goal utilities must reach by Phase 2 (2000) of the new Clean Air Act.

CCI created the process because its product must be cleaned at a very fine particle size. Kindig estimates that only about a third of today's beneficiation processes clean coal with a particle size fine enough to produce Carefree coal.

PRODUCT RETAINS MORE THAN 90% OF ITS HEATING VALUE

This technique uses a fine magnetite suspended in water to separate run- of-mine coal into three product divisions: clean coal, refuse and middlings. After separation, middlings are sent to a cycloning device, which rapidly spins the particles to induce additional separation.

The middlings are then crushed to liberate coal and refuse into two distinct elements. Additional clean coal in a fine form is recovered while pyrite, sulfur and ash are rejected. Clean coal is then combined with the fine, finished coal product from the middlings.

Kelly estimates that it would cost between $30 million and $60 million to replicate a facility capable of yielding 600-700 tons/hr of the Carefree product. He said the exact pricetag for Carefree coal would vary with each customer depending on the cost of the coal used and the degree of cleaning required. In addition to selling the clean coal product, CCI is now helping several coal companies explore ways to customize their plants to produce Carefree and Self-Scrubbing coals.

Self-Scrubbing pelletized coal takes the technology a step further by adding limesone-based chemicals to remove between 70%-80% of organic sulfur during combustion. Seen as a low-cost compliance alternative when compared with coal switching or scrubbing, the weather-resistant pellets allow more raw coal to be used.

"Not only will the coals clean up SO_2 emissions, they will also use large amounts of raw coal - high-ash coal, for example - that is now just being wasted," said CCI Vice President Robin Godfrey.

CCI plans to sell Carefree and Self-Scrubbing coal, most probably in Pennsylvania, by mid-1992, three years before the 1995 Phase 1 deadline. The company has no plans at this time to produce any additional clean coal.

THE PUR LETTER

Letter No. 2981 February 15, 1991

SELF-SCRUBBING COAL PREVIEWED

A new technology, which combines advanced coal cleaning and combustion techniques, may provide an alternative to scrubbers, or switching to low-sulfur coal, to comply with the new federal clean air standards, Duquesne Light Co., spokesmen said this week.

The technology would be "particularly appropriate" for many of the 1,100 existing unscrubbed coal-fired boilers, according to Sheldon Wool, president of Custom Coals International, a joint venture formed by the Pittsburgh-based Duquesne Light Co., and Genesis Research Corp., of Carefree, Az., to market the process.

Named "Self-Scrubbing Coal," the technology involves the production of a marble-size, pelletized coal product from which more than 90% of the pyritic sulfur has been removed in a coal preparation plant of unique design. The use of the pellets do not require major modifications to utility boilers, according to Robert Horton, president and COO of Genesis.

Additives that have been combined with the coal react during the combustion process to capture 70% to 80% of the remaining organic sulfur. Overall, spokesmen said, from 70% to 90% of the total sulfur content of many coals can be removed.

"Because of its ability to eliminate a high percentage of the sulfur from virtually any coal, the technology will allow a utility to use locally mined coal preserving local mining jobs," said Wesley W. von Schack, chairman and CEO of Duquesne.

Commercial-scale testing of the technology, which was developed by Duquesne Light and Genesis over a six-year period, recently was completed at the EPRI's coal quality facility at Homer City, Pa. The technology is expected to be available for commercial application next year, Horton said.

In the Nation's Capital

NES DRAFT PUSHES PRODUCTION OVER CONSERVATION

A legislative draft of the administration's national energy strategy (NES) leaked last Friday provides for oil and gas production incentives, deregulates oil and natural gas pipelines, encourages the revival of nuclear power, amends the PUHCA, and provides for the use of alternative fuels in vehicle fleets. The final NES plan is expected to be presented at a February 21 Senate energy panel hearing.

Key provisions of the draft:

- Authorizes the sale of federal oil and gas leases on the ANWR and allows oil companies to buy leases in U. S.-owned oil fields in California.
- Abolishes the FERC's regulation of oil pipelines, lessens restrictions on natural gas pipelines, provides for natural gas pipeline rate deregulation and ends regulation of imported natural gas.
- Excludes Exempt Wholesale Generators from the requirements of the PUHCA; and, removes the 80 MW cap from PURPA qualifying facilities.
- Simplifies the licensing of hydro projects and exempts projects of 5 MWs or less from licensing requirements.
- State commissions are not pre-empted from prudency review of wholesale purchase of electricity.
- Provides for a combined nuclear construction and operating license based on compliance with the acceptance criteria of the license. Eliminates the current requirement for DOE to obtain state permits to characterize the Yucca Mountain, Nev., candidate nuclear waste repository site, and provides for early siting of an MRS temporary waste facility.

Conservation measures include encouraging energy-efficiency lighting technology. The draft does not request new energy taxes or provide for more stringent auto fuel efficiency standards above the current 27.5 mpg.

Evidently deleted from the OMB draft, circulated for final federal agency review, were measures that would have provided for a federal energy efficiency standard for electric lights, a federal energy efficiency fund to promote loans to U. S. agencies for conservation projects, and a tax credit for electricity production by solar, wind, geothermal and biomass fuels.

FERC REJECTS MARKET-BASED RATES IN SP/NPC TRANSACTION

By a 3 to 2 vote, the commission this week rejected the Sun-Peak (SP) power purchase contract to sell 210 MW of peaking capacity to Nevada Power Co., (NPC) at market-based rates. Sun-Peak is affiliated with Southern California Edison Co., and Mission Energy, both subsidiaries of SCE.

In its decision, the commission majority found that the SP had failed to present sufficient evidence "to demonstrate that it is not a

A FINE SOLUTION?

DUQUESNE IN ADVANCED COAL CLEANING VENTURE

If oranges can be "sun kissed", then coal can be "care-free". Or so hopes Duquesne Light Company, anyway. It is embarked on a joint venture with Arizona-based Genesis Research Corporation on the notion that it can take a utility's existing high sulfur coal supply and, using one of two new processes, achieve reductions of 90% in pyritic and 70% of the remaining sulfur during combustion. And if the venture, known as Custom Coals International (or CCI), can back up these claims at a cost beating the going rate for SO_2 reductions, it will make its backers more than just care-free.

Still some doubts remain. Although the process units have been tested at commercial scale at CQ Inc.'s Homer City Plant, a complete facility has yet to be constructed. And early tests of the simultaneous firing of limestone and coal on a large scale basis did not work well. Subsequent work, such as DOE's LIMB project, have been more successful, but have yet to be demonstrated in utility boilers.

The Medium Is The Massage

How does CCI propose to do it? Explains Genesis Research President Robert Horton, "With the exception of coal, every other minerals dressing business begins with crushing and separation of materials. So far, nobody has developed a fine coal cleaning process that worked." Mr. Horton asserts that the only other contender, froth flotation, also floats out the pyrite as well, contributing to higher pyritic sulfur content of the resultant product.

Where CCI does it better, Mr. Horton notes, is by constructing a heavy-media preparation plant which uses ultrafine magnetite (down from 20 microns to 2 microns). The advantages are twofold. First, CCI can clean very small coal particles, or "fines" (for the initiated, down from 28 mesh for conventional coal cleaning all the way to 500 mesh or microns) Second, the ability to clean smaller particles also permits greater recovery of coal in the resultant product, which CCI calls "Carefree Coal", while leaving behind the inert material. Mr. Horton claims that the CCI process achieves "72% yields, as opposed to the 65% commonly associated with conventional coal cleaning," for a 10% improvement. Thus, "Where you would have gotten 1 million tons from a conventional cleaning plant, you get 1.1 million tons from ours," he notes, asserting that this helps offset the plant's higher capital and operating costs.

While sulfur reduction capabilities vary widely among coals, a typical bituminous coal might split 60-40 in the ratio of pyritic to organic sulfur. Thus, 90% reduction of pyritic sulfur in Carefree coal amounts to a 54% reduction in overall sulfur. Such a reduction level would be sufficient for many coals in meeting Phase I targets. For example, CCI did a test run on a Sewickley seam 3.0 lbs SO_2 per million Btu coal for Duquesne, reducing it to 1.06 lbs after heavy media cleaning.

Nothing Could Be Finer

However, many utilities are resistant to burning coal fines, which among other things are difficult to transport and store. CCI has an answer for them: pelletization. One industry source estimates that pelletizing costs between $10-15 per ton, potentially rendering pelletized Carefree coal uncompetitive with run-of-mine lower sulfur coals on a delivered basis.

Mr. Horton of Genesis counters that CCI plans to use a pelletizing process patented by Thermac, a British company, which currently produces 40,000 tons per year through a non-thermal method. The Thermac process should cost roughly $7 per ton, he contends. Furthermore, Mr. Horton expects that only 10-20% of the product will require pelletization, further reducing the cost to less than $2.00per finished ton.

Self-Scrubbing Coal?

While 54% sulfur reduction may be sufficient for Phase I, it will not cut it for Phase II in most cases. The next step, according to Mr. Horton, is to take a product cleaned as described above, and add dolomitic limestone, soda ash, and iron oxide. These materials are intended to react with the remaining sulfur during combustion as both sorbent and catalyst in order to remove 70-80% of the resulting SO_2 from the coal. Duquesne's Sewickely seam coal was further cut to 0.35 lbs SO_2 per million Btu after such treatment, Mr. Horton reports.

Here the evidence is problematic. Utility companies have tried to introduce sorbents into the boiler at many points, but have had the most difficulty with anything prior to post-combustion alternatives. Previous attempts at Wisconsin Electric Power, Pennsylvania Electric, and TVA's Paradise plant have all encountered problems with reactivity of the sorbent.

Gobs of Money

Surprisingly, one of the most promising areas for CCI to make inroads could well be in the cleaning of coal wastes, commonly referred to as "gob piles". "We can make our own product from refuse, if we have to," says Mr. Horton. The inability and/or unwillingness of buyers to burn coal fines in the past has meant that coal below a certain size was discarded. If the costs of cleaning and pelletizing are added on top of a costless feedstock such as coal wastes, then any uncertainty about cost competitiveness would be alleviated.

Coal Contracts as "Untapped Borrowing Capacity"

Mr. Horton is particularly impressed with the attractiveness of CCI's offerings to companies that are capital-constrained. Mr. Horton believes there is substantial untapped off-balance-sheet borrowing capacity in coal contracts. If a

(continued on page 8)

TVA WEIGHS SCRUBBING
(continued from page 6)
confident of the $225-$250 per kilowatt capital cost estimates that TVA has relied upon. "Some of our retrofits will cost less than that, and some will cost more." However, he cites as an additional uncertainty in the costs of scrubbing the availability of Phase I bonus allowances: "will EPA pro-rate? will it be first-come first-served?"

Asked if TVA is counting on bonus allowances to justify the economics of the retrofit decision, Mr. Golden is cryptic: "TVA will have a strategy that will enable us to be in compliance." He adds for emphasis "there are other things to be done with Phase I allowances than sell them." However, he acknowledges that TVA has the potential for being a "player" in the allowance market.

-Thaddeus J. Huetteman

Other Options/Other Places: Gas? Duct Injection?

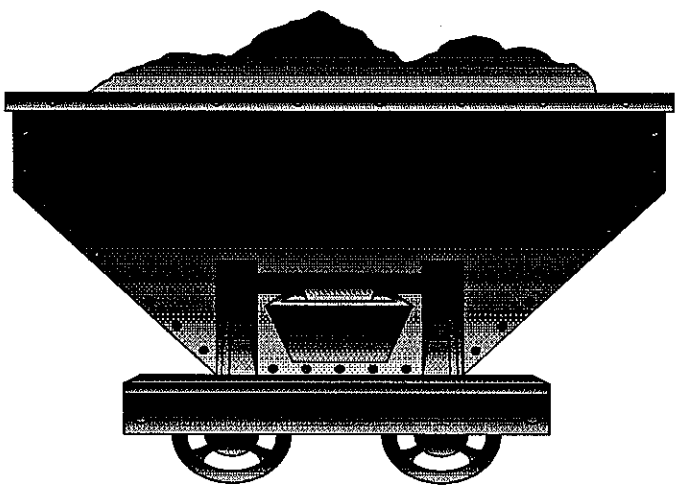
That no option had been foreclosed was underscored as Mr. Golden reviewed the rest of the system. Natural gas? "TVA plants are within 20-25 miles of the three major natural gas pipelines," including Tenneco, Texas Eastern, and Columbia Gas. He noted that TVA's Allen station, located in Memphis, is another cyclone unit which used to burn natural gas. Given the fact that the industry still does not know definitively where NO_x regulations are going, natural gas reburn may look advantageous as a technique to reduce emissions of nitrogen oxides. Duct injection? Mr. Golden feels that such technology might be appropriate for the few thousand tons at the margin, but that "for Phase I plants we prefer a higher SO_2 removal efficiency."

DUQUESNE'S COAL VENTURE
(continued from page 6)
utility has trouble borrowing because of construction cost disallowances, "all they have to do is to sign a fuel purchase contract and we can finance the plant and deliver the compliance coal to them," he offers.

-Thaddeus J. Huetteman

NEES CONTRACTING STRATEGY
(continued from page 4)
companies (LDCs) to open up unutilized space on the interstate pipelines through "capacity brokering." While skeptical as to how quickly such a market will develop, Mr. Rilkoff sees a potential big benefit: "the room for profitable capacity trading between LDCs and electric companies is great, considering their needs are very different." Gas company demand, he notes, is very weather sensitive.

TEST PROGRAM



CUSTOM COALS TEST PROGRAM

The test program has been designed to provide increasing levels of confidence in the technology at reasonable costs with an opportunity to withdraw after any Phase if the results are not satisfactory.

Phase I

Phase I provides data on the sulfur reductions achievable through the processing of subject coals into either Carefree or Self-Scrubbing Coals. The data are obtained through detailed laboratory washability and liberation assessments to provide information from which pyritic sulfur removal (through aggressive cleaning) and organic sulfur removal (through the use of additives) can be projected. This work can be performed for a fixed cost of $17,000 per coal with a turnaround time of four weeks from the first full working day following receipt of the coal sample.

Phase II

Phase II produces laboratory data and economic simulations of the cost and quality of a Custom Coals product made from the raw coal selected by the customer. The economic simulation is based on power generation costs as determined by EPRI's Coal Quality Impact Model. This work can be performed for a fixed cost of $115,000 per coal with a turnaround time of 11 weeks from the first full working day following receipt of the coal sample. This phase consists of three parts:

- Coal Cleaning Flowsheet Performance and Cost Modeling
- Power Station Performance Modeling

Each part provides the data required by the following part. The laboratory washability and liberation information will be used in determining the performance and cost of the coal cleaning plant flowsheets. Coal quality and cost is then used to predict power station performance and costs.

Phase III

Phase III will generate a pilot-scale combustion evaluation of a Carefree or Self-Scrubbing Coal. The selected coal will be cleaned to the customer's specifications at CQ, Inc. The coal will then be shipped to a major boiler manufacturer's combustion laboratory for a pilot-scale test burn. A boiler performance evaluation using a boiler performance model will be performed. Phase III of the test program can be completed within three months from receipt of coal. Preliminary combustion results will be presented within six weeks and a final report completed

(over)

within eight weeks after finishing the pilot test burns. This work can be performed for a fixed cost of $250,000 per pilot test series. The combustion performance test will include investigations of:

- Combustion
- Furnace Ash Slagging
- Convection Pass Fouling
- Fly Ash Erosion
- Emissions
- Precipitator Impacts